LANDSCAPE EVALUATION IN SOUTHERN POLAND USING THE „BA LVL"

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1. INTRODUCTION

In July 1996 and 1997, the Department of Geography at the University of Basel held their physiogeographical research fieldwork in southern Poland. The focus of the fieldwork was to collect data on the geoecofactors relief, soil, climate, flora and fauna (according to the method by Leser & Klink, 1988), as well as to the map the results. Furthermore, pedotopes were to be defined. For the last couple of decades, fieldwork with a similar focus has been held in the region of Basel. Thus the method has been tested over a long period of time. With the help of contacts to the Geography Department of the University of Warsaw it was possible to implement these methods in a different natural environment in Eastern Europe. In 1997, an additional element was integrated into the fieldwork: landscape assessment. In order to implement the assessment, several functions and processes relevant to the landscape budget were evaluated on the basis of the *Guidelines for Assessing the Capacity of the Landscape Budget* (Anleitung zur Bewertung des Leistungsvermögens des Landschaftshaushaltes – BA LVL), as described in Marks et al. 1989.

1.1. ASSIGNMENT AND GOALS

The aim of the herein described project was to implement the BA LVL in a test area in southern Poland and to evaluate the methodology and practical application. The BA LVL is defined as an „objektive Methode zur Beurteilung der räumlichen Strukturen, Nutzungen, Funktionen und Potentiale in Hinblick auf das Leistungsvermögen des Naturhaushaltes der Landschaft" (Marks et al. 1989, 28 – as an objective method for evaluation of spatial structures, production, functions and yield with regards to the performance capacity of the natural landscape budget). This method depends on a holistic knowledge of the functional relationships within the targeted ecosystem to be able to evaluate landscapes in their structural and functional complexities. Only so is it possible to avoid placing anthropic land-use and land-use change in the foreground.

On the basis of the geoecological data collected during the fieldwork according to the methods described in Leser & Klink 1988[1], an attempt was made to implement the BA LVL in the same research area. Furthermore, the possibility of formulating a value-free description of the performance capacity of a landscape was investigated closer.

The data collected during the fieldwork of 1996 (see Tab. 1) was used for evaluating **soil erosion susceptibility** (both water and wind erosion) as well as the **biotic yield potential** of the region and for producing the necessary maps. The evaluation itself was based on the principles of the BA LVL. Of further importance was the time aspect during an evaluation in a situation where no geoecological map 1:25 000 (GÖK 25) is available and the majority of the raw data has to be collected locally. The validity of a system developed in western Germany (here the BA LVL) in a transitional area like the continental European landscape was a further focus of the project; in particular so, as the climate, the soils and the land-use in Poland differ greatly to west-European landscapes.

1.2. DESCRIPTION OF THE RESEARCH AREA

The research area is located just north-west of Pinczów, a city with ca. 12 000 inhabitants in the region of Wojewodschaft Kielce, ca. 70 km north-east of Krakow. According to the landscape zoning of Poland, Pinczów is located in the centre of the geographical macro-region of the Nida-Basin. The basin itself belongs geographically to the Lesser Polish plateau (Ostaszewska, 1997). The research area stretches over an area of 3,5 km^2 and can be divided into five basic zones when working from the south-west to the north-east (see Fig. 1).

- In the south-west, a slightly inclined plain with south-westerly exposure stretches towards the Nida-floodplain. The plain is used intensively for agriculture. The bedrock is marl (Upper Cretaceous).
- The bordering rolling to hilly relief elements have a similar exposure to the plain in the south-west. Miocene limestone dominates the relief characteristics. A large excavation site (a former lime stone quarry) is located in the eastern section of this relief segment. Tillage is to be found in the sloping regions. Forest and meadow however are also typical land-use forms. The latter in particular occurs on south-facing banks in the former quarry. Here, „steppe" (plant community – Inuletum ensifoliae) have been able to develop.
- A plateau forms the central zone of the research area. Pleistocene sand was deposited on the lime stone. Pine and birch forestry dominate the land-use.

[1] The book is at present available as a revised edition in Zepp & Müller, 1999.

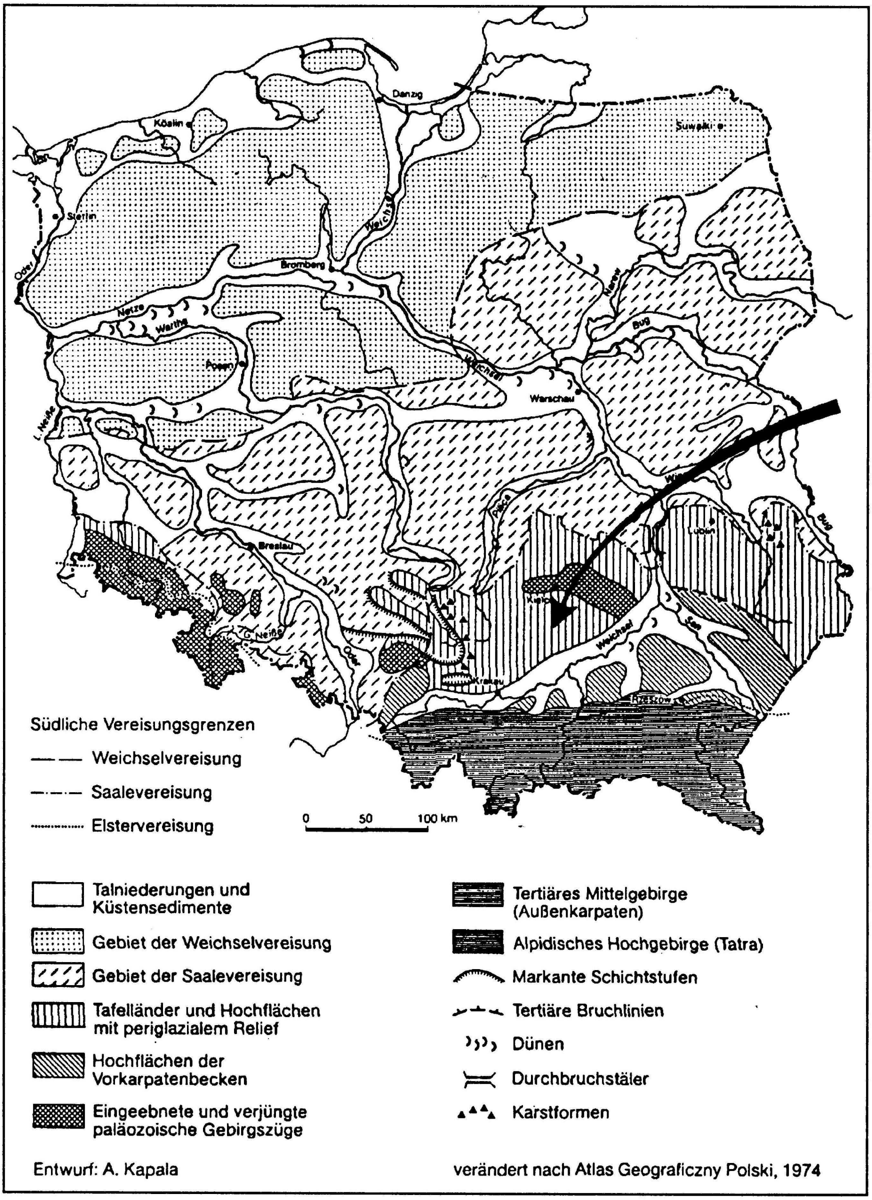

Fig. 1. Location map of study area

- The north-western slopes are covered predominantly with a loess-layer. Below the forest border, meadow is to be found. Sand and peat dominate as substrates on the slightly inclined slopes in the north-eastern section of the research area. Tillage and meadow dominate as agricultural forms.

For detailed information concerning the research area, see Potschin & Leser (1996, 1997) and Wicik (1996).

2. METHODOLOGY

The investigation took place within the scope of an eight day research trip to Pinczów in 1997. Basic data was available from the field trip in 1996, which students from the Geographical Department of the University of Basel had collected during a physio-geographical fieldwork. In 1997, land-use and vegetation maps were completed of the research area and the available soil data completed. Spatial gaps in the data were likewise filled.

In the foreground of the chosen method of investigation is the performance capacity of the landscape budget. The concept is defined by it's authors as „das aus der räumlich-materiellen Struktur, Funktion und Dynamik sowie aus den Substanzen, Energien und Prozessen der landschaftlichen Ökosysteme resultierende, für alle Lebewesen jeweils wichtige Leistungsvermögen des Landschaftshaushaltes" (Marks et al. 1989: 32 – a performance capacity which combines those spatial-materialistic structures, functions and dynamics as well as the material, energy and processes within the landscape budget that are important for all living creatures). The difference between this method and other landscape evaluation methods is that the evaluation of the performance capacity occurs independently of the projected goal. The same procedure is implemented in every situation. The method thus claims to describe the landscape budget objectively (Hase, 1992: 23).

The method presumes that the performance capacity of a landscape budget is the sum of the prevailing functions and potentials. Functions are understood as the duties and performances of a landscape; potentials refer to the available resources of economic interest and to specific objects (MARKS et al. 1989: 33). The functions and potentials are to be investigated and evaluated according to specific regulations. The method takes **five functions and three potentials** in the landscape budget into consideration:

Functions:

1. Soil/Relief
2. Water
3. Climate/Air
4. Biotic factors
5. Recreational factors

Potentials:

1. Water availability
2. Biotic yield potential
3. Geographic potential (landscape)

In the ideal situation, a geoecological map at the scale of 1:25 000 (GÖK 25) serves as the source of the necessary data. The BA LVL however may be implemented without a GÖK 25 on condition that the necessary data is available and that the interaction of the individual geoecofactors is taken into consideration during the evaluation. Although no GÖK 25 was available for the research area[2], data collected according to the principles of the GÖK 25 was available. The data however, was not available in the form of homogenous spatial units, but as single monitoring points or in the form of thematic maps (see Potschin & Leser, 1996; Potschin & Leser, 1997).

Due to a shortage of time, it was not possible to consider all the functions and potentials of the landscape budget. The investigation had to be limited to erodibility and to the biotic yield potential. The decision appears justified despite these limitations, as it is still possible to test the implementation of the BA LVL. Furthermore, criticism of the methodology is also feasible under these conditions.

2.1. Soil Erosion Susceptibility

According to the BA LVL, the first function to be investigated is the soil erosion resistance. In other words, the aim is to find out to what extent both the interaction of the geoecofactors on a spatial unit and the budget processes counteract prevailing wind and water erosion. To be able to make any statements about the above, it is necessary to investigate the resistance of a soil to water erosion. The aim is to find out the mean soil yield in t/ha*a, taking the following parameter into consideration (tab. 1).

Each of the above parameter is assigned a value or a class. Thus, every site or homogeneous area reflects a combination of several parameter values. On the basis of the value combination, it is possible to calculate the site specific erosion resistance.

The values of the individual parameter are transferred to maps. With the help of map overlays, units of similar soil erosion resistance may be identified.

The same principle is used to determine soil resistance to wind erosion. The relevant parameter, i.e. soil type, degree of soil moisture and organic matter content are taken into consideration.

Finally, to be able to calculate the erosion resistance of the individual areas, the presumption is made that the prevailing agricultural activity is one during which the highest

[2] To the situation of GÖK 25 sheets in Germany, see Potschin (forthcoming).

erosion rates are to be expected. It is thus possible to establish the level of resistance available in the individual sites in connection with current land-use.

Tab. 1. Parameter necessary for the investigation of erosion resistance (EWF: Erosionswiderstandsfunktion) and biotic yield potential (BEP: biotisches Ertragspotential) according to the BA LVL. (GP = data collected and completed during the excursions of 1996 and 1997. BA LVL = data which either needed to be calculated, specifically investigated or derived. *USLE = Universal Soil Loss Equation by Wischmeier and Smith)

Necessary parameter	**Function or potential investigated**		**Data collected**	
	EWF	BEP	GP	BA LVL
Soil type	+	+	+	
Stone content	+	+	+	
Organic matter content	+		+	
Slope form (longitudinal and cross-section profiles)	+		+	
Slope inclination	+	+	+	
Rainfall intensity (average rainfall value according to USLE *)	+			+
Land-use	+		+	
Soil depth	+	+	+	
Nutrient content		+		+
Depth of ground-water level		+		+
Standing water		+	+	
Available field capacity		+		+
Ecotope water supply		+		+
Average annual temperature		+		+
Danger of frost		+		+
Flooding		+		+

2.2. BIOTIC YIELD POTENTIAL

Biotic yield potential is defined as „das Leistungsvermögen des Landschaftshaushaltes, ertragsmässig verwertbare Biomasse zu erzeugen und die ständige Wiederholbarkeit dieses Vorganges zu gewährleisten" (Marks et al. 1989: 36 – the performance capacity of the landscape budget to produce yield related biomass and to ensure the continuity of this production).

A similar procedure to that mentioned above for soil erosion resistance was used to investigate biotic yield potential. On the basis of the necessary parameter listed in Tab. 1, it is possible to define units with site specific characteristics. The biotic yield potential is determined using map overlays of the various parameter.

The method described above led to the completion of several maps: resistance of soil to water erosion, resistance of soil to wind erosion, general soil erosion resistance, biotic yield potential. To be able to check the interpretative quality of the maps, it was necessary to compare the results with observations made in the field.

3. RESULTS

3.1. METHOD IMPLEMENTATION

What follows is a list of the difficulties that came to light during the implementation of the BA LVL:

- The first step of the method is to determine the soil-type induced erodibility according to a table (Tab. 1 in Marks et al. 1989: 55). Herein, every soil type is linked to an erodibility class. The problem is that the classification system works with a very fine division, whereas the available soil data for the research area was based on less detailed field results. The classification thus proved difficult in some cases. For example: the table provides different results for the soil types „l'S" and „l*S". As the „lS"[3] defined for the research area was not classed further, an interpretation had to be made without scientific backing, as to which of the two classes open for choice was more suitable. The level of inaccuracy increases if several such decisions need to be made for the one or other class. It remains open if the expected accuracy of soil type determination is at all necessary considering the time consumption.
- A potential source of error is the classification procedure by slope inclination. The BA LVL expects a finer classification of slope inclination classes than is available in existing slope inclination maps. This is particularly so for moderate inclination. It was thus necessary to work with averages. The conscious decision to work less accurately is justifiable as the BA LVL condenses the results during a process of evaluation to three classes anyway. As a consequence, a strong generalisation of the research results takes place.
- The definition of homogeneous areas according to their geoecological characteristics (geoecotopes) proved to be of far greater difficulty. It was not possible to determine homogeneous areas on the basis of data points, as all the factors should to be taken into consideration. It proved necessary to first determine homogeneous areas for each individual parameter. Spatial distribution maps of the individual parameter where then overlaid to enable the interpretation of geoecological units. The results were however, very small spatial units and the decision-making process included a great deal of interpretation.
- The BA LVL proved to be exceedingly time consuming. First of all, the basic data was collected by 12 students during 2 five-day fieldwork-periods. Secondly, 2 × 40 working hours were necessary for the evaluation of the data. Thus, to determine a single function and a potential in a research area of 3.5 km^2, more than two man-weeks were necessary (if data extraction is excluded).

[3] LS = loamy sand, l'S and l*S = minor variations of loamy sand

3.2. SPATIAL EVALUATION

3.2.1. ERODIBILITY

When discussing erodibility (see Fig. 2 and 4), a difference is made between wind and water erosion. A maximum of six classes are defined during the evaluation procedure. The BA LVL then calls the results to be condensed to three classes (low – moderate – high).

Areas with high erodibility risk through water are all in regions with moderate to steep slopes. A surprising element of the evaluation was the crystallisation of areas with high erosion risks despite appropriate land-use. This was in particular so for the forest regions of the north-eastern slopes. On the other hand, very steep slopes to the west of the research area only had a low erosion risk. It appears that relief and land-use alone do not dominate the erosion risk classification. The process of evaluation considers organic matter content, soil depth and in particular, soil type of equal importance. Thus, the loess deposits to the north east of the research area explains why the soil in the region is defined as having a high erosion potential and the agricultural activity on the soils to the south west is the main reason for the high erosion risk there.

The forests in the research area generally serve to minimise erosion risk (see Fig. 3). Thus, if tillage were to be introduced in such areas, the erosion rate would increase. The BA LVL only makes provision for the mapping of areas with a moderate to high importance for erosion protection. These areas were to be found on the north eastern slopes of the research area and in the afforested regions of the ex-quarry.

The determination of wind erosion risk (Fig. 4) painted a very different picture. The dominantly sandy regions of the research area were defined in particular as having a high erosion risk: i.e. the plateau and wide stretches on the slopes and plains to the north east and the south west. The steep slopes themselves have a low risk. The question is raised if agricultural land should be evaluated differently to meadow and forest regions. The reason lies in the differences between ground cover, wind velocity and soil humidity prevalent in each zone.

Generally it may be said that with the help of erosion maps it is possible to determine the erosion risk in the research area in a fair amount of detail. The information regarding erosion risk may be used together with the results of land-use mapping to determine areas where land-use change would have a positive effect on erosion in an area, i.e. where it would make sense to change arable land into meadow or forest. Likewise, where land-use change is a topic in landscape planning and project implementation, the above results on erosion risk could be useful. Thus, erosion risk is an important factor for defining the value of an area, be it it's economic value or it's value in the system.

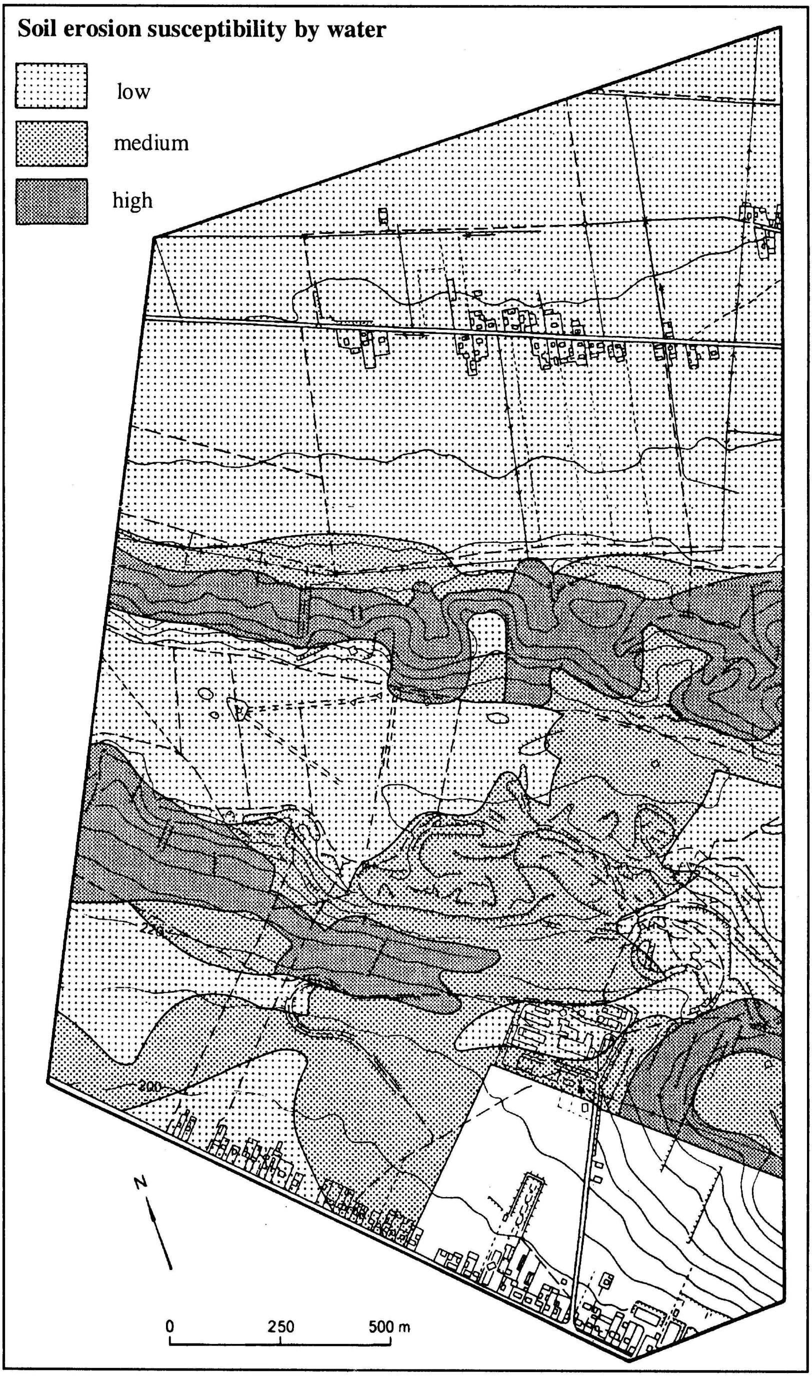

Fig. 2. Soil erosion susceptibility by water

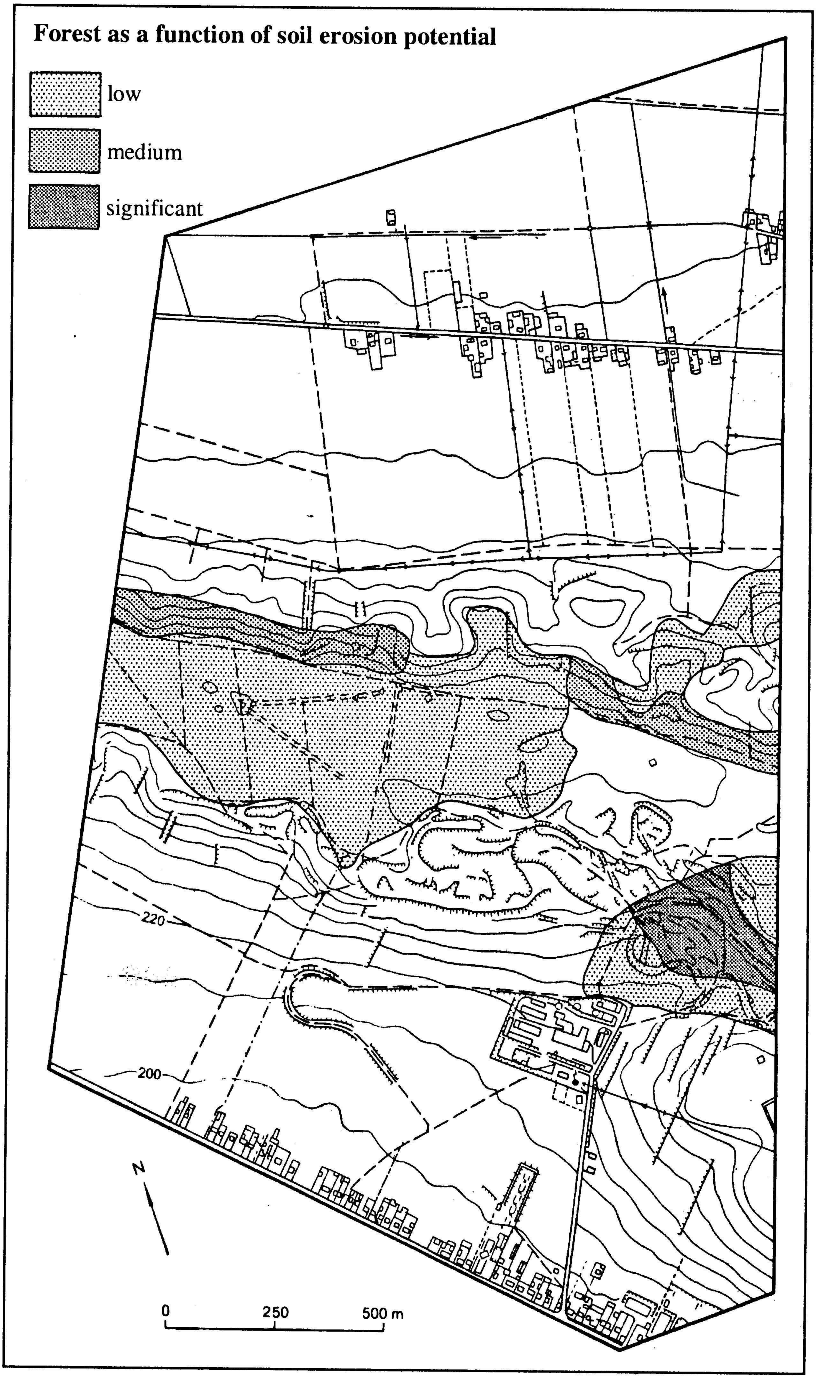

Fig. 3. Forest as a function of soil erosion potential

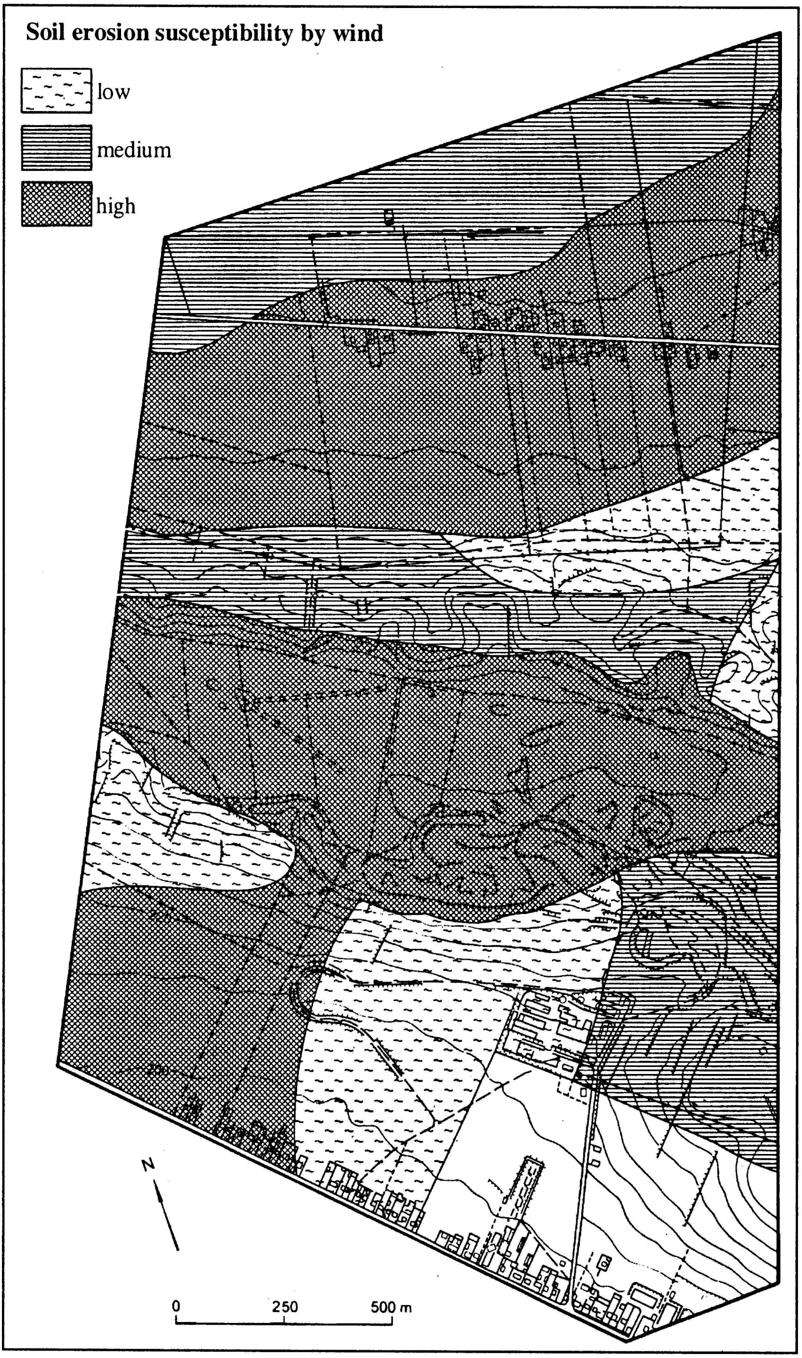

Fig. 4. Soil erosion susceptibility by wind

3.1.2. Biotic Yield Potential

Individual units in the research area have at most a moderate biotic yield potential (see Fig. 5). The areas are in the arable zones of the plains. Most of the fields only have a low to very low yield capacity. The forest regions lie in this latter classification as well. Two fields lying in the south-west of the research area were described as having a high erosion risk. Both fields were recommended for land-use change. The alternatives suggested were meadow or forest use.

Like the results for erosion risk, the results on biotic yield potential may also be used for testing the suitability of a specific agricultural practice for an area. Suggestions for necessary change may be based on the results. The biotic yield potential may also be used to estimate the value of agricultural areas.

4. Discussion

From a scientific point of view, the BA LVL proved to be suitable for implementation in Poland as the necessary data (Tab. 1) had been collected during the previous fieldwork. Difficulties were observed with regards to certain functions e.g. ground water protection, nature conservation. In Germany, these functions cause less of a problem as the necessary data is available, be it in the form of endangered lists for plants and animals or depth of ground-water level maps. In Poland, the above information is not available or if it is available, then in a very different form. The evaluations aimed for in this paper were relatively easily implemented using the BA LVL. The results themselves also appeared to be useful, although the following limitations should be mentioned:

- As the soils in Poland tend to have a generally lower biotic yield capacity than soils in Germany, it appears necessary to adapt the scale of evaluation to take a finer differentiation in the moderate to low yield section of the table into consideration.
- The results of the erosion risk potential appeared to be valuable. However, it is necessary that the evaluation procedure is tested under local conditions, taking local erosion rates into consideration. Due to the smaller fields in Poland, the lower employment of heavy machinery and the wider field border strips, it is possible that different erosion mechanisms dominate to those in Germany. It was surprising, that despite the high frequency of rainfall and the partly heavy showers, there was at times no noticeable indication of erosion (the fieldwork took place during the Oder flood-of-the-century in 1997 in southern Poland). It is possible, that the BA LVL estimated soil loss rates that were too high for the research area. A similar problem was found by Fröhlich et al. (1994: 9) during research in the region of Basel, Switzerland.

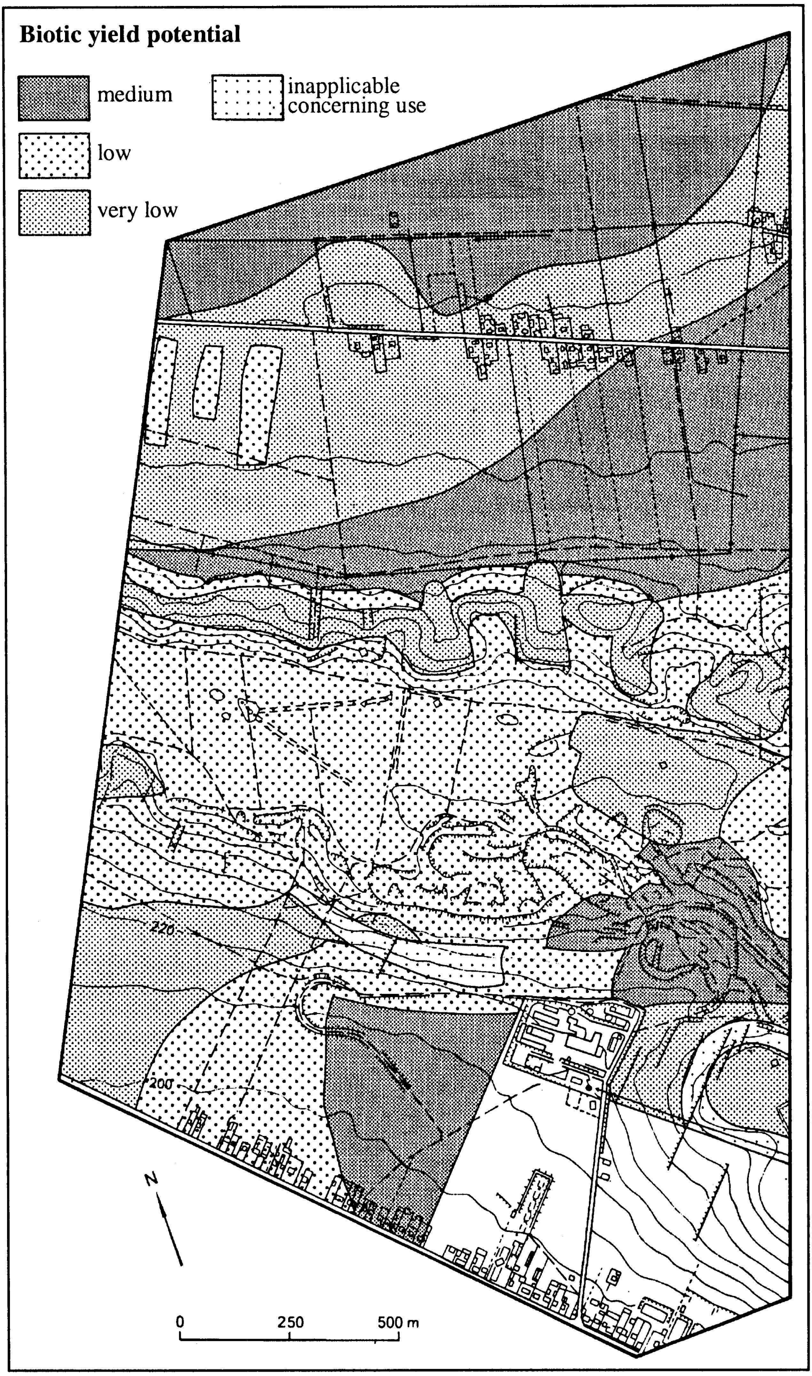

Fig. 5. Biotic yield potencial

From a practical point of view, the work load necessary to implement the BA LVL for landscape evaluation is so high that the question is raised if the method is suitable for practical application at all. It is possible that a GÖK 25 map of the research area could have decreased the work-load considerably. However, even in such a situation, the time needed to determine all the potentials and functions in the research area would be disproportionate to the work load of other methods. Besides the arguments above, it should be mentioned that at present there is only a limited number of GÖK 25 maps available for Germany. Thus, time-consuming data research would belong to the norm when working with the BA LVL. Furthermore, if the exactness of the results is compared to the work-load necessary to attain such results, it becomes apparent that alternative methods might achieve similar results with less work involved. It appears necessary to investigate which results in the maps (Fig. 2 to Fig. 4) were only possible once the BA LVL had been applied.

The implications of the above statement can be described satisfactorily on the basis of soil erosion risk. The question is which areas in the erosion risk maps generated by the BA LVL could have been defined simply by taking relief and land-use into consideration. If it were presumed that steep slopes have a high erosion risk, then a topographical map of the region would be sufficient for defining areas of potentially high erosion. Tillage is considered an erosion maximising factor in the BA LVL. If this knowledge is used to interpret the erosion risk on slopes with moderate and steep inclination, then the quantity of areas with high erosion risk increases. The BA LVL however, did highlight regions that had a high erosion risk although they were being used correctly from the land-use point of view. As mentioned before, this was in particular so for the north-western slopes of the research area. Despite suitable land-use, the erosion risk was high. Soil type (in this case highly erodible loess) was the decisive factor here.

As a consequence, it appears as though soil parameter need to be taken into consideration if the results are to be satisfactory. Thus, the definition of pedotopes in a research area appears unavoidable. However, the demand for extensive data surveys is put into relation when one considers that the herein described investigation was held at a scale of 1:10 000 and not at the scale foreseen by the BA LVL, i.e. 1:25 000. If the research had been done at the latter scale, the results would have been less detailed. Additionally, if the stipulation in the BA LVL to ignore all areas smaller than 4 ha had been followed, then the pedotopes that were mapped would have been less exact as well. The question is raised if pedotopes defined under the above conditions would have been more exact or entailed more information than pedotopes roughly defined according to substrate maps. Although rough definitions in the form suggested above are controversial from a scientific point of view, it appears certain that the BA LVL will have to be adapted in this direction if it is to find acceptance amongst it's potential users.

On the whole, the aim of the BA LVL to evaluate several landscape functions and potentials clearly and objectively is to be greeted. The method could prove to be an important tool for delivering the necessary information in every-day decision-making processes (e.g. land-use planing; land-use optimisation; environmental impact assessments – EIA; etc.).

5. CONCLUSION

The investigation showed that the BA LVL, as a landscape evaluation method, could be implemented in continental landscape regions like that of Lesser Poland. The investigation and the evaluation of the individual functions and potentials should however be adapted to the data availability in the respective region or country.

Despite the fact that the BA LVL has several standardised procedures, in many areas it was still not possible to dispense with the interpretation capabilities of the individual user. On the other hand, the demands made by the method for exact data is necessary, if it is to stay scientifically viable as a method of evaluation.

In conclusion it may be said that the BA LVL is suspended in the typical conflict zone of geoecosytem research. Whereas exact scientific work is demanded, it is not possible to avoid a loss of information during the aggregation, classification and generalisation of the components interacting in a complex ecosystem.

6. SUMMARY

The goal of the herein described project was to implement the Guidelines for Assessing the Capacity of the Landscape Budget (Anleitung zur Bewertung des Leistungsvermögens des Landschaftshaushaltes – BA LVL) in a test area. The methodology and practicality of the guidelines were evaluated. Based on the data collected during fieldwork in Pinczow (Lesser Poland) in July 1996 and 1997, the geoecofactors relief, soil, climate, flora and fauna were defined. Due to time limitations, the investigation focused solely on soil protection functions and biotic yield potential.

The result of the spatial evaluation are maps with a relatively high resolution. With the aid of these maps, conclusions concerning erosion potential and biotic yield potential could be made. Information won in this way could be used for landscape planning as well as for projects combined with land-use change.

From a practical point of view, the question is raised whether the high labour intensity of Guidelines for Assessing the Capacity of the Landscape Budget is suitable for practical application. If the accuracy of the results are set in relation to the work load, then

it is possible that an alternative estimation method would bring similar results and be less time-consuming.

It is apparent that the Guidelines for Assessing the Capacity of the Landscape Budget is situated in the ever present conflict zone between scientific demands and practical applicability.

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STRESZCZENIE

Celem niniejszej pracy jest przetestowanie *Wytycznych do oceny wydajności krajobrazu* (Anleitung zur Bewertung des Leistungsvermögens des Landschaftshaushaltes – BA LVL) pod kątem ich metodyki i przydatności praktycznej. Poligonem badawczym były okolice Pińczowa. Podczas prac terenowych przeprowadzonych w lipcu 1996 i 1997 r zebrano liczne dane na temat komponentów krajobrazu: rzeźby, gleb, klimatu, flory oraz fauny. Z przyczyn czasowych uwagę skupiono na funkcjach ochrony gleb oraz potencjale produktywności biotycznej środowiska.

Wyniki badań wskazują, że mapy uzyskane dzięki zastosowaniu zasad BA LVL odznaczają się dużą dokładnością, a ich treść dostarcza wielu danych, przydatnych do wykonania oceny zagrożenia gleb erozją oraz do

określania biotycznego potencjału krajobrazu. Dane te mogą znaleźć zastosowanie zarówno w planowaniu przestrzennym, jak i podczas realizacji projektów związanych ze zmianą sposobów użytkowania ziemi.

Z praktycznego punktu widzenia, przydatność instrukcji BA LVL jako podstawy oceny krajobrazu budzi jednak wątpliwości. W zestawieniu z wiarygodnością wyników, nakład pracy konieczny do ich uzyskania wydaje się bardzo duży. W związku z tym pojawia się pytanie, czy do tych samych wniosków praktycznych nie doprowadziłoby zastosowanie mniej czasochłonnych metod oceny.

Jak się okazuje, instrukcja BA LVL jest kolejnym opracowaniem, sytuującym się w strefie konfliktu między wymogami poznania naukowego a stosowalnością praktyczną.

Katarzyna Ostaszewska