Agro-economic potentials of the East Slovak Lowland agricultural soils

Agroekonomické potenciály pôd Východoslovenskej nížiny

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Abstract: The high rate of the Stagnosols and Gleysols in the East Slovak Lowland substantially influences the potential utilisation of the existing agro-ecosystems. On the basis of the pedologic and informative system of Slovak soils investigation, we determined the possible structural, productive and economic parameters of the soil representatives in the East Slovak Lowland, its districts and soil-ecological regions with the help of geographic informative systems. 46.9% of the soils are not profitable for the plant growing without subsidies. At the average expense per one hectare of agricultural soil 10 227 SKK, it is possible to expect the yields of approximately 10 295 SKK/ha, which means profit without subsidies 68 SKK/ha (profitability rate 0.67%). The best natural and economic results in plant production can be expected in the Michalovce and Trebišov districts and the soil-ecological regions of Ondavská rovina (Ondava flatland), Laborecká rovina (Laborec flatland) and Kapušanské pláňavy (Kapušany welds).

Key words: East Slovak Lowland, productive ability of soils, economic parameters of soils, profitableness of plant production

Abstrakt: Vysoké zastúpenie pseudoglejových a glejových pôd na Východoslovenskej nížine výraznou mierou ovplyvňuje potenciálne využitie existujúcich agroekosystémov. Na základe pedologického prieskumu a informačného systému o pôdach Slovenska sme za pomoci geografických informačných systémov stanovili potenciálne možné štrukturálne, produkčné i ekonomické parametre pôdnych predstaviteľov za Východoslovenskú nížinu, jej okresy a pôdno-ekologické regióny. Bez dotácie štátu je tu pre pestovanie rastlín až 46,9 % pôd nerentabilných. Pri priemerných nákladoch na 1 hektár poľnohospodárskej pôdy 10 227 Sk je možné očakávať výnosy na úrovni 10 295 Sk/ha, čo aj bez dotácii predstavuje zisk 68 Sk/ha (miera rentability 0,67 %). Najlepšie naturálne i ekonomické výsledky v pestovaní plodín je možné očakávať v okresoch Michalovce a Trebišov a pôdnoekologických regiónoch Ondavská rovina, Laborecká rovina a Kapušanské pláňavy.

Kľúčové slová: Východoslovenská nížina, produkčný potenciál pôd, ekonomické parametre pôd, rentabilita pestovania plodín

INTRODUCTION

In spite of various discussions concerning the ways of the most effective agricultural utilisation of the East Slovak Lowland, it has been a typical agrarian ecosystem. Agricultural intensity here depends much more on the existing climate, soil and water management conditions than in other regions of Slovakia. With regard to the geographic location of this region, these conditions are unique and in the mutual complex they substantially specify and predetermine the agrarian potential of the region.

The level of economic results in agriculture is closely connected with the way of using the country. It is certain, that there will always be the differentiation in the yields and reached economic results of certain soils depending on the heterogeneity of soil qualities also in spite of the best structure of using the production potentials of the soil. Due to the relatively balanced climatic condition, the East Slovak Lowland is a suitable region for testing.

Without regard to the recent economic situation and agricultural sector budget and financial predividing, it is obvious that the East Slovak Lowland soils are able to produce, under rational agricultural utilisation, such commodities, which are interesting as to the quality, quantity and the economic point of view.

The content and the aim of this report is to show the possible potential of natural and economic effectivity of agricultural soils and also the soil categorisation from the agricultural crop growing point of view.

MATERIAL AND METHODS

The following sources were used for our investigation:
– data of the Soil Science and Conservation Research Institute on the soil-ecological unit of land and its

point evaluation in one hundred point scale (Džatko 2002);
– categorisation of the soil unit of land parameters (Linkeš, Pestún, Džatko 1996);
– data of the economic parameters of the soil-ecological unit of land in Slovakia (Vilček 1999).

Natural parameters were given on the basis of the final software for optimal organisation and using of the agricultural soils – PEDOPT 2000 (Vilček 1999). With the help of the geographic informative system ARC INFO, we differentiated and quantified, on the basis of the vector land evaluating maps in scale 1 : 5000, the potential rate of the vegetable production profitability as well as the chosen crops in the soils of Slovak areas. The soil parameters of the East Slovak Lowland were differentiated according to the former districts (Michalovce, Sobrance, Trebišov a Vranov nad Topľou – a part), and the main soil-ecological regions as well (Džatko 2002). The particular regions are as follows:

311 – Medzilaborec welds and Latorica flatland
312 – Ondava flatland
313 – Laborec flatland and Kapušany welds
321 – Malčice tabula and Pozdišovce back
322 – Podvihorlat upland
323 – Podslaná upland
4610 – Zemplín hills

Besides these regions, there are marginally, especially in the districts of Vranov nad Topľou and Sobrance, included also the regions 457 – Slánske hills, 458 – Vihorlat hills and 4410 – Ondava highlands.

RESULTS AND DISSCUSSION

The East Slovak Lowland (ESL) represents the North-Eastern foreland of the Potiska lowland. It spreads at the area of 2 500 km^2. The geomorphologic development of the region is reflected in spreading of the soil representatives, mostly in Fluvisoils and Hydromorphicsoils, as well as in the character of the soil-forming processes. They are mostly gley and pseudo-gley processes. Huge areas of the lowland are influenced by the high level of the ground water that conditioned the formation of the soil gleyisation and in some parts also formation of the salinized soils.

The soil is mostly used as agricultural soil (about 69% of the region), 68% of it represents arable land. Farmers grow there the thick-sown crops (37%), grain maize (10%), leguminous plants (5%), oil plants (10%), sugar beet (5%), annual fodder crops (8%) and perennial fodder crops (12%). It is necessary to say that the recent use of agricultural soils is not in accordance with the productive potential of the region. Especially heavy, gley soils are often used as arable soils.

It can be seen in many authors´ contributions that the ESL is not a homogeneous unit regarding the geomorphology and soil. Pedologic investigation confirmed the occurrence of several soil types and groups. Their area depends on the character of the main soil-forming processes, that is the character of transformation and migration of the substances and energy in the surface part of the earth crust and mutual influence of the soil-forming factors: climatic (precipitation amount, air temperature), biological (vegetation, animals, micro-organisms), geomorphologic and geological (substrates and parent materials of the soils). In accordance with the latest Morpho-genetic and Classification System of Slovak soils, we are able to define 9 groups, 17 types and many subtypes, varieties and forms of the soils in the given region. These soils are mutually different in their morphology and genesis and from the point of view of the farmers, also in their productive ability and economic efficiency. The way of using the soils is an important task as it mainly predetermines the production and economic potentials of the given region.

On the basis of a long-term investigation concerning the problem of ESL soils, using of the existing data on productive and economic parameters of the soil-ecological unit, it can be concluded that the soil is the component of the natural environment which differentiates and predetermines the way of using this country and its agro-economic prosperity. The yields potential of agricultural soils of the ESL is presented in Table 1. The first two categories within the topologic-productive categorisation of the Slovak soils (the most productive and the highly productive arable soils) are not represented in the given region. The highest share is represented by the so-called productive arable soil and typical for this region are the so-called alternate fields. Evaluating the potential of agricultural soils of the region, the best is the district Michalovce – 55 points (in one hundred scale within Slovakia), followed by Trebišov – 54 points, Vranov nad Topľou – 47 points and Sobrance – 46 points. From the point of view of soil-ecological regions, the best quality is in the region of

Table 1. Structure of yield potentials in East Slovak Lowland (%)

Typological-productivity categories of soils	% a.l.
Very productive arable soils	11.3
Productive arable soils	28.6
Medium productive arable soils	7.8
Less productive arable soils	6.1
Low productive arable soils	0.2
Medium productive arable soils and productive grassland	21.8
Less productive arable soils and productive grassland	0.9
Low productive arable soils and productive grassland	3.5
Productive grassland	0.4
Less productive grassland	17.9
Low productive grassland	0.7
Territories unsuitable for agro-ecosystem	0.8

the Laborec flatland and Kapušany welds – 59 points, while in the region Podvihorlat upland, it is only 44 points. This difference of the conditions is expressed in the gradual decrease of the carve suitable for the growing of the field crops. 52 points is the average amount for all ESL.

With regard to the structure and quality of these soils concerning the permit retaining of the existing yields potential of the agricultural soils, the following structure of its using seems to be suitable:

Arable soils	65.8%
including: thick-sown crop	43.8%
maize for grain	5.7%
leguminous plants	4.3%
sugar beet	1.4%
potatoes	4.5%
oil plants	5.7%
annual fodder crops	11.1%
perennial fodder crops	21.7%
Orchards, gardens, vineyards, hop-gardens	6.1%
Permanent grassland	28.1%

Table 2. Potentials of natural production of ESL soils

Crop	Production	
	t/ha	ESL total (thousand t)
Winter wheat	5.13	200
Winter rye	4.13	11
Spring barley	5.09	127
Maize	4.90	45
Peas	2.60	14
Sugar beet	36.0	80
Sunflower	2.78	9
Winter rape	2.46	13

Yields potential of the East Slovakia Lowland (ESL), with regards to the existing soil-ecological conditions enables to reach suitable potentials of natural production at the recent technologies and manufacturing ways and also respecting the needs of the crop concerning the nutrition (Table 2).

It is obvious, that the heterogeneous crop-forming potential of the soils is reflected in the differentiation of economic parameters of vegetable production. The survey of the share of agricultural soils with regard to the potential economic profitability of growing crops is undoubtedly interesting. To compare, there are also the average values in Slovakia presented (Table 3).

It is shown, that while in Slovakia there are 36% of soils non-economic for winter wheat, it is only 2.3 % in the ESL. As to grain maize, this ratio is app. 60% to 48%, for sugar beet 61% to 40% and for winter rape 31% to 19%.

It can be concluded generally for all vegetable production, that without subsidies, 46.95% of the agricultural soils are uneconomic at the present economic rules, 14.0% are low profitable, 16.9% medium profitable and 22.2% highly profitable for crop growing in the East Slovak Lowland. In spite of the absence of very highly profitable soils (rate of profitability over 10%, the given parameters, in comparison to the similar categorisation for all Slovakia, include the East Slovak Lowland among the regions suitable for agriculture. It is documented by the potentially possible economic parameters, which can be reached there (Table 4). At the average expenses per hectare of the agricultural soil 10 227 SKK/ha, it is possible to expect yields approximately 10 295 SKK/ha, what represents profit without subsidies 68 SKK/ha (rate of profitability 0.67%).

Allocation of the soil representatives with their economic potential significantly influences the economics of the crop growing. While in the districts of Michalovce and Trebišov, there are Chernozems and Hapli-Gleyic Chernozems and a higher rate of Fluvisols found, in dis-

Table 3. The share of soils from the point of view of costs profitability of grown crops (%)

Profitability category	Winter wheat	Maize	Sugar beet	Winter rape	Potatoes	Crop production total
East Slovak Lowland						
Soil non-profitable	2.3	47.5	39.5	19.2	77.2	46.9
Soil low profitable	5.1	9.6	11.6	41.3	7.5	14.0
Soil medium profitable	47.8	20.7	9.9	23.3	15.3	16.9
Soil highly profitable	27.9	22.2	39.1	16.2	–	22.2
Soil very highly profitable	16.9	–	–	–	–	–
Slovak Republic						
Soil non-profitable	36.3	59.5	61.0	31.3	74.9	54.4
Soil low profitable	15.8	3.1	1.3	31.2	4.9	13.9
Soil medium profitable	13.7	12.9	3.4	17.3	6.1	7.3
Soil highly profitable	21.4	15.4	22.4	13.6	9.3	10.6
Soil very highly profitable	12.8	9.1	11.9	6.6	4.8	13.8

tricts of Vranov nad Topľou and Sobrance, there dominateas to the granularity heavier Stangnosols, Gleysols, or Cambisols. The similar representation of the soils is also in the evaluated soil-ecological regions. For the Laborec flatland, Kapušany welds, Malčice tabula, Pozdišovce back and Ondavská flatland, there are typical Chernozems, Hapli-Gleyic Chernozems, Luvisols and Albic Luvisols. The typical soil types in the Podvihorlatska upland are Gleyic Fluvisols, Gleysols, Gleyic Luvisols, Stagnosols and Cambisols. This soil representation differentiates also the expected productive and economic results of plant production. Differentiation of the supposed economic parameters of the agricultural soils according to the districts and soil-ecological regions is given in more details in Tables 5 and 6.

The obtained data confirm that the production and economic potential of the agricultural soils in the East Slovak Lowland includes this region among the more productive agro-ecosystems. Utilisation of all given parameters depends mostly on human factor within the region and outside as well. It is necessary to be more attentive to recognising the soil ability for growing the

Table 4. Real soil economical parameters of ESL

Soil type	Share (%)	Costs (SKK/ha)	Revenues (SKK/ha)	Profit (SKK/ha)	Profitability rate (%)
Chernozems	4.5	18 183	19 624	1 441	7.92
Hapli-Gleyic Chernozems	0.5	18 434	19 936	1 502	8.15
Mollic Gleysols	2.0	15 056	15 842	786	5.22
Luvisols	6.0	12 365	13 312	947	7.66
Eutric Fluvisols	7.0	13 044	13 503	459	3.52
Gleyic Fluvisols	32.5	11 100	11 061	–39	–0.35
Albic Luvisols	2.8	9 607	9 685	78	0.81
Cambisols	10.5	6 979	6 706	–273	–3.91
Stagnosols	17.6	8 635	8 475	–160	–1.85
Regosols	2.5	9 795	10 285	490	5.00
Rendzic	0.2	5 020	4 631	–389	–7.75
Gleysols	13.1	7 337	6 952	–385	–5.25
Solonetz	0.2	3 064	2 646	–418	–13.64
Leptosols	0.5	1 837	1 530	–307	–16.71

Table 5. Economic potentials of the soils according to the districts

District	Costs (SKK/ha)	Revenues (SKK/ha)	Profit (SKK/ha)	Profitability rate (%)
Michalovce	10 572	10 650	78	0.73
Sobrance	8 908	8 769	–139	–1.56
Trebišov	10 627	1 0791	164	1.55
Vranov n/T.	9 331	9 285	–46	–0.50

Table 6. Economic potentials of the soils according to soil-ecologic regions

Region	Costs (SKK/ha)	Revenues (SKK/ha)	Profit (SKK/ha)	Profitability rate (%)
311	10 420	10 547	127	1.22
312	11 241	11 469	227	2.02
313	11 213	11 419	206	1.84
321	11 484	11 763	279	2.43
322	9 510	9 442	–68	–0.71
323	10 875	11 014	139	1.28
4610	9 973	10 036	63	0.63

particular agricultural crop and to the effective production and economic regionalisation of agricultural production in the East Slovak Lowland.

CONCLUSION

Soils of the East Slovak Lowland have their regional features and specific character. Numerous representations of the genetic representatives under the relatively balanced climatic conditions are caused by the difference of the soil climate, subjected to the configuration of the terrain and granularity of the parent material, which depended on the different humidity of the soils.

It can be seen, that it is possible to produce a moderate profit in plant production without subsidies. Recently, with respect to the wrong using of the soil fund, it is not certain.

Utilisation of agricultural soils is given by their character and also by the weather development. Yield potentials of the regional soils predetermines them to the agricultural use. The best natural and economic results in crop growing can be expected in the district of Michalovce and Trebišov and the soil-ecological regions of the Ondava flatland, Laborec flatland and Kapušany welds.

It must be said, that compared to the other Slovak lowlands, the agricultural crop growing is more difficult regarding the economic aspects, mainly because of the soil conditions.

REFERENCES

Čurlík J., Ševčík P. (2000): Tibreg – Prieskum prírodných zdrojov vo vzťahu k životnému prostrediu v styčnom regióne Slovensko-Maďarsko-Ukrajina. (Záverečná správa), VÚPOP Bratislava, 68 s.

Džatko M. (2002): Hodnotenie produkčného potenciálu poľnohospodárskych pôd a pôdno-ekologických regiónov Slovenska. VÚPOP Bratislava, 88 s.

Hronec O. a kol. (2000): Prírodné zdroje. Royal Unicorn, Košice, 235 s.

Kromka M., Bedrna Z. (2002): Hygiena pôdy. 1. vyd., Univerzita Komenského, Bratislava, 88 s.; ISBN 80-223-1602-4.

Linkeš V., Pestún V., Džatko M. (1996): Príručka pre používanie máp bonitovaných pôdno-ekologických jednotiek. VÚPÚ, Bratislava, 103 s.

Vilček J., Litavec T., Gutteková M. (1998): New approaches to the bonity information system interpretation. Vedecké práce VÚPÚ č. 21, Bratislava: 91–100.

Vilček J. a kol. (1999): Pôdno-ekologické parametre usporiadania a využívania poľnohospodárskej krajiny. (Záverečná správa), VÚPOP Bratislava, 113 s.

Vilček J. (2001): Produkčný a ekonomický potenciál pôd Východoslovenskej nížiny. In: Agroekologický potenciál Východoslovenskej nížiny z hľadiska produkčného, environmentálneho a ekonomického [Zborník referátov z vedeckej konferencie], OVÚA Michalovce: 110–114.

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