SOIL BONITATION AND LAND VALUATION WITH D-*e*-METER SYSTEM AS A TOOL OF SUSTAINABLE LAND USE

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Introduction

The importance of land valuation is increasing all over the world (Burrough, 1987, Rossiter, 1996,). Paralel to present day technical improvements, there are newer and newer concepts formulated for effective soil bonitation and land valuation (Lemmens and Kurm, 2000).

In Hungary after the one and half century utilization of the „Gold Crown" land value index (Dömsödi, 2006), in spite of new initiatives (Fórizs et al., 1971) there is no functional modern land valuation. In order to improve the sustainability of the land use and to facilitate the land appraisal, a new soil bonitation index was developed (Gaál et al., 2003). The new system is based on the D-*e*-Meter soil quality index (or bonitation number) which is calculated on-line with the help of a complex Geographical Information System of soil and other maps.

The concept of D-*e*-Meter soil quality index has being extended from croplands for other land uses, such as grasslands (Dér, 2003) and forests (Bidló et al., 2003).

In our earlier publications we described the concepts and difficulties of coupling the physical characteristics of lands (Hermann et al., 2006, Tóth et al., 2006a) as shown by the D-*e*-Meter soil quality index with the economics of land use (Tóth et al., 2006b, c).

The necessary following step of the development was the detailed conceptualization of the land valuation and its realization in the GIS system and this publication will focus on these achievements (Szűcs et al., 2006, Fekete et al., 2006).

Materials and methods

The development of the on-line system has been described earlier by Vass et al. (2003). The fundamental data sources are the soil maps prepared at 1:10,000 scale. Characteristics of the working system were reported by Tóth et al. (2006d, e, f). The study site is a contiguous area of Zala county as it is shown on Figure 1.

Results and discussions

Land valuation algorithm

As reported earlier (Tóth et al., 2006c) the land value is closely connected to the D-*e*-Meter soil quality index. There are a set of correction factors to be considered when the land value is calculated as shown by Table 1 for croplands.

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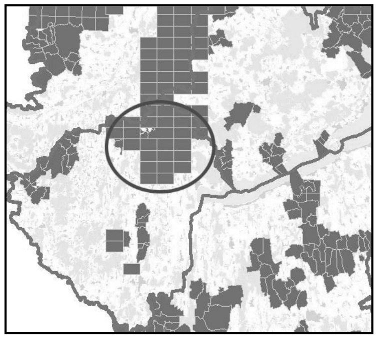

Figure 1. The study site in southwestern Hungary on the right bank of the river Zala before it flows into lake Balaton. The rectangles indicate the 1:10,000 scale genetic soil maps, the bordering lines at southwest and northwest are the international borders.

Table 1. The correction factors considered for calculating the land value of croplands

Correction Factors

Noz.	***Definition of factor***	***Situation***			***Correction of total standard gross margin (factor)***
		Unfavourable	***Intermediate***	***Favourable***	
1.	***Fragmentation of the area***	<10 ha >200 ha	10 –200 ha		0,97 1,00
2.	***Possibility to irrigate*** -functioning underground pressure tube network, -water access from canal, -functioning tubewell	***available/not available***			1,15 1,15 1,15
3.	***Obstructive objects in the field (elements of infrastructure)*** -10-40 m wide zone of both sides of power line	there is more then one line crossing the area	there is one line crossing the area	there is no line crossing the area	0,80 0,90 1,00
4.	***Accessibility of the area*** -length of paved road per ha of agricultural area	0 km	1 km	> 1 km	0,85 1,00 1,15
5.	***Infrastructure*** a) distance to nearest interchange (railroad, fluvial, processing industry)	> 5 km	1-5 km	< 1 km	0,90 1,00 1,10
	b) a settlement with more than 100 inhabitants	within a circle of 5 km radius	1-5 km	within a circle of 1 km radius	0,85 1,00 1,15
	c) road conditions, accessibility of motorways	> 30	15-30	< 15	0,90 1,00 1,10
6.	***Distance from waste storage facility*** a) in case of hazardous wastes,	1-2 km	2-5 km	> 5km	0,85 0,95 1,00
	b) in case of non hazardous wastes,	0,5-2 km	2-5 km	> 5 km	0,85 0,95 1,00
	c) in case of inert wastes.	0,3-1 km	1-2 km	> 2 km	0,85 0,95 1,00

The correction factors are read from digitized soil maps, therefore their interpretation is completely automatic in the GIS system.

Utilization of the D-*e*-Meter system for sustainable land use planning

Based on the slope categories of the digital elevation model (DEM) several important decisions can be made. The areas which must be excluded from plowing can be easily delineated. In the European Union, based on the requirements of „Good farming practice" areas with slope gradient exceeding 12 degree must not be cropped with row crops. Relatively simple operation is the delination of those areas where the steep gradient of the land causes overconsumption of engine fuel.
On Figure 2 increasingly dark tones indicate the patches of our Zala study site with increasing clay content. Considering such maps is indispensable due to the evident effect of soil texture on soil cultivation requirements, fuel requirement and length of growing season as well.

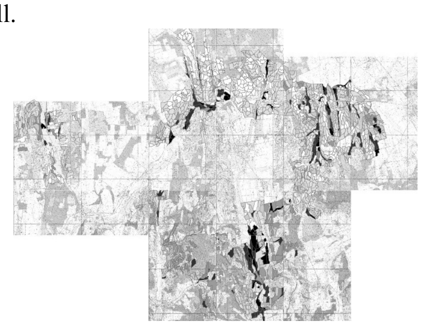

Figure 2. Map of soil texture. Lightest tone shows sand, black shows clayey texture.

Conclusions

Based on the existing GIS system for the on-line calculation of D-*e*-Meter soil quality index of agricultural plots, we developed the framework of land value calculation. According to our experience the available digital maps can be effectively utilized for the automatic calculation of D-*e*-Meter land value from the soil quality index. Moreover the digital database creates further opportunities to improve the sustainability of land use by optimizing fuel utilization, crop rotation etc.

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References

Bidló A. et al., 2003. Forest habitat classification in Hungary and its problems. In: Land Valuation and Land Use Information. (Eds.: Gaál, Z., Máté, F. & Tóth, G.) (In Hungarian) 115–124. Veszprém University. Keszthely.
Burrough P. A. 1987. Mapping and map analysis: new tools for land evaluation. Soil Use & Management.3: 20–25.
Dér F. et al. 2003. Habitat evaluation of grasslands. In: In: Land Valuation and Land Use Information. (Eds.: Gaál, Z., Máté, F. & Tóth, G.) (In Hungarian) 125–130. Veszprém University. Keszthely.
Dömsödi J. 2006. Land use. (In Hungarian) Editorial Campus. Budapest-Pécs.

 DOI: 10.1556/CRC.35.2007.2.264

Fekete Farkas M. 2006. Externalities in agriculture. (In Hungarian) Agroinform K+F. Supplementum. 2006. june, pp. 16-18. ISSN 1786-6219.
Fórizs J. – Máté F. - Stefanovits P. 1971. Soil bonitation – land valuation. (In Hungarian. MTA Agrártud. Oszt. Közlem. 30:359–378.
Gaál Z. - Máté F. - Tóth G. (Eds.), 2003. Land Valuation and Land Use Information. (In Hungarian) Veszprém University. Keszthely.
Hermann T. – Makó A. – Máté F. – Tóth G. – Tóth Z. 2006. Soil fertility assessment in a case study in Hungary. Cereal Research Communications. 34:199-201.
Lemmens M. J. P. M. - Kurm J., 2000. Integrating GIS with a Land Valuation Information System: some non-technical considerations for the Estonian case. In: Proc. UDMS 2000, 22nd Urban Data Management Symposium, Delft. (Ed.: Fendel, E. M.) IX. 15–23.
Rossiter D. G. 1996. A theoretical framework for land evaluation. Geoderma. 72:165–202
Szűcs I. - Farkasné Fekete M. - Dobó E. 2006. Market characteristics of croplands. (In Hungarian) pp. 339-343 ("Az agrárinnovációtól a társadalmi aszimmetriáig", szerk.: Jávor A.-Borsos J.). Debreceni Egyetem, 2006. ISBN963927495 X
Tóth B. – Makó A. – Rajkai K. - Szabóné Kele G. – Hermann T. – Marth P. 2006a. Use of soil water retention capacity and hydraulic conductivity estimation in the preparation of soil water management maps. Agrokémia és Talajtan 55: 49-58.
Tóth T. - Németh T. - Fábián T. – Hermann T. – Horváth E. – Patocskai Z. – Speiser F. - Vinogradov Sz. – Tóth G. 2006b. Internet-based Land Valuation System Powered by a GIS of 1:10,000 Soil Maps 18th World Congress of Soil Science Abstracts (CD)
Tóth T. - Németh T. - Fábián T. – Hermann T. – Horváth E. – Patocskai Z. – Speiser F. - Vinogradov Sz. – Tóth G. 2006c. Internet-based Land Valuation System Powered by a GIS of 1:10,000 Soil Maps. Agrokémia és Talajtan 55: 109-116.
Tóth T. - Németh T. - Horváth E. - László P. - Bidló A. - Dér F. - Fekete M. - Fábián T. - Gaál Z. - Heil B. - Hermann T. - Kovács G. - Makó A. - Máté F. - Mészáros K. - Pásztor L. - Patocskai Z. - Speiser F. - Szűcs I. - Tóth G. - Várallyay Gy. - Vass J. - Vinogradov Sz. 2006d. Establishment of a new land valuation system in Hungary. (In Hungarian) III. Magyar Földrajzi Konferencia Tudományos Közleményei. MTA Földrajztudományi Kutatóintézet. ISBN 963 9545120. MTA Budapest. 2006. szeptember 6-7. (CD)
Tóth T. - Németh T. - Máté F. - Tóth G. - Gaál Z. - Szűcs I. - Makó A. - Horváth E. 2006e. Land quality, land value and sustainable land use among the conditions provided by the European Union. (In Hungarian) Talajtani Vándorgyűlés. Sopron 2006. aug 23-25. Abstracts. P8.
Tóth T. – Németh T. – Bidló A. – Dér F. - Fekete M. - Fábián T. - Gaál Z. - Heil B. - Hermann T. - Horváth E. - Kovács G. - Makó A. - Máté F. - Mészáros K. - Patocskai Z. - Speiser F. - Szűcs I. - Tóth G. - Várallyay Gy. - Vass J. - Vinogradov Sz. 2006f. The optimal strategy to improve food chain elements cycles-development of an internet based soil bonitation system powered by a GIS of 1:10 000 soil type maps. Cereal Research Communications. 34: 841-844.
Vass J. et al., 2003. Information technology of D-*e*-Meter internet-based land bonitation system. In: Land Valuation and Land Use Information. (Eds.: Gaál, Z., Máté, F. & Tóth, G.) (In Hungarian) 57–77. Veszprém University. Keszthely.