ZNALOST ZMĚN VYUŽITÍ PŮDY JAKO NEZBYTNÝ PŘEDPOKLAD ROZVOJE VENKOVA – NĚKTERÉ METODICKÉ ÚVAHY O OPUŠTĚNÍ PŮDY

KNOWLEDGE OF LAND USE CHANGES AS A PREREQUISITE OF RURAL DEVELOPMENT - SOME METHODICAL CONSIDERATIONS ON LAND ABANDONMENT[48]

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Anotace:
Mít znalosti o změnách využití půdy je pro řízení rozvoje venkova důležité, zejména jestliže dojde k nežádoucím změnám. Opuštění půdy je v Rakousku stále častější a problematický jev. Současné výzkumné projekty mají za cíl rozvoj metod předpovědí založených na GIS ke stanovení pravděpodobnosti budoucího opuštění půdy na zemědělskou půdu. Tento "prvotní varovný systém" by měl poskytovat užitečnéinformace pro budoucí venkovské plánování. Může být součástíkomplexního venkovského půdního informačního systému a měl by zajišťovat, aby přínos řízení zdravého rozvoje čistě převýšil náklady na získávání informací.

Klíčová slova:
Změny využití půdy, rozvoj venkova, informační systém, GIS, opuštění půdy

Summary:
Having knowledge about land use changes is relevant for managing rural development particularly if undesirable changes occur. Land abandonment is an increasing and problematic phenomenon in Austria. A current research project aims at developing a GIS-based forecasting method to assess the probability of land abandonment on agricultural land in future. This "early warning system" should provide useful information for future rural planning. It may be part of a comprehensive rural land information system and it should ensure that benefits of a sound development controlling clearly exceed the costs for information acquisition.

Key words:
Land use change, rural development, information system, GIS, land abandonment

INTRODUCTION

Land use changes are a result of rural development but they also determine development options of a region. Understanding and forecasting changes in land use is essential for stimulating a sustainable rural development. Politicians and decision makers need information about land use changes for land use planning, agri-environmental subsidies, nature conservation, tourism planning etc. Over the last decades a range of models has been developed to get knowledge about the past, the ongoing and the future trends in agricultural land use change (LAMBIN et al., 2000). Different agricultural trends can be observed in rural areas all over Europe: intensification, concentration, extensification, marginalisation and

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abandonment of agricultural land (JONES and CLARK, 1997). Depending on the natural conditions and the geographic location in some parts of Austria (e.g. in less favoured and mostly remote areas) decline of farm holdings and land abandonment ("the end-result of agricultural marginalisation" [VERSCHUUR et al., 2003, 21]) occur. Forest expansion (+ 2.700 km² since 1960; BFW, 2004) as well as an increase of set-aside arable land (+ 1.000 km² since 1970; BMLFUW, 2004) are obvious signs of land abandonment. Managing retreat of agriculture and its impacts requires information about areas that will be affected in future. For providing this knowledge a GIS-based model will be developed and its information-economic impacts will be discussed.

OBJECTIVES AND METHODS

This paper intends (i) to introduce a micro-scale (parcel level) model in order to forecast the probability of land abandonment (PROBAT), (ii) to show an opportunity of embedding it in a comprehensive information system for regional spatial development, and (iii) to consider knowledge-economic aspects of its implementation.

Methodically, PROBAT is based on findings about land abandonment, (mostly regional scaled) land use models derived from literature screening. The model will be developed by using a deductive approach (based on both micro-economic and behavioural theory) and considering research pragmatic aspects (data availability, costs). Costs (broken down into types of costs, showing cost differences depending on various factors) and potential benefits (different users gaining multiple material and immaterial benefits) of using PROBAT in practice will be discussed to provide a knowledge-economic assessment framework. In further steps the mainly theoretical model considerations as well as the cost-benefit-aspects need to be proved empirically.

RESULTS

Information systems and databases documenting land use changes

Findings about information systems and databases documenting land use changes will be pointed out by considering land abandonment as an example. Currently different methods for gaining and transferring knowledge about agricultural land use and forestry and its changes are applied in Austria, like Agricultural Structure Survey, IACS (Integrated Administration and Control System), digital cadastral map and real estate data, CORINE Land Cover, Austrian Forest Inventory. However, official agricultural data do not contain explicit figures about the total extent of abandoned agricultural land (grassland, arable land, wine yards etc. taken out of production); furthermore small farms (where cessation of cultivation is more likely than on larger farms) are excluded. This lack of sound information makes it difficult to monitor and manage land abandonment.

If decision-makers and planners want to deal with this phenomenon they need knowledge about it, e.g. areas of future land abandonment, underlying causes or short-term and long-term impacts. Solid land information is necessary to develop future regional concepts, guiding principles and land use scenarios as well as to take measures in order to achieve defined objectives and to control whether targets have been met. Inadequate knowledge leads to wrong decisions and misinvestment. One attempt to fill a part of the information gap is PROBAT. It should be embedded in a regional land information system (see figure 1) and it should inform about future land abandonment.

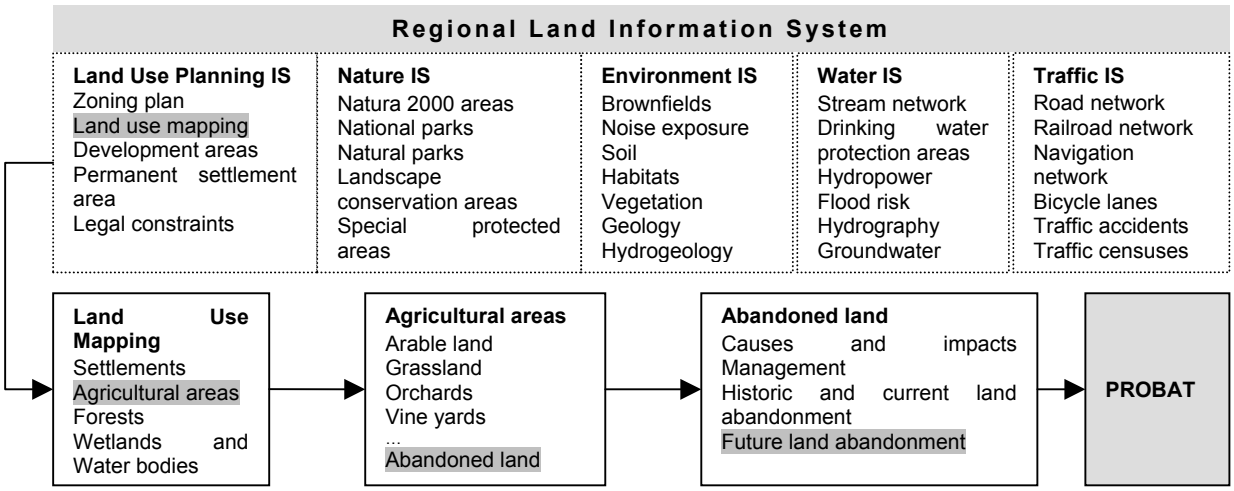

Figure 1: Embedding of PROBAT in a regional land information system

Modelling future land abandonment (PROBAT)

PROBAT is a GIS-based model at parcel level (see figure 2). Based on various driving forces for land abandonment mentioned in literature, like environmental factors, geographic location, agricultural structures, social, economic and policy factors (BALDOCK et al., 1996), determinants which are likely to be relevant for the parcel level were derived according to selection criteria (e.g. reference to parcel level, data availability). PROBAT considers parcel characteristics as well as political and legal factors, personal and farm-related determinants and individual behaviour patterns of the farmers. Integrating individual behaviour patterns with natural, socio-economic and economic factors is a novelty regarding the modelling of land abandonment. The variables will be combined by using a specific algorithm in order to calculate the occurrence probability of land abandonment per parcel. A map showing these probabilities will be the output.

Determinants	parcel characteristics			political and legal determinants	personal and farm-related determinants		individual behaviour patterns
Variables	slope	soil quality	potential yield distance to farm ownership	area-related subsidies	standard gross margin of the holding size of the holding type of farming age of the farmer education of the farmer	successor	attitudes to landscape conservation future perspectives
Input (Data)	digital elevation map	digital soil map	digital cadastral map / real estate data	IACS	Agricultural Structure Survey	own survey	
Data processing	Transformation of all data to parcel level combination by using GIS calculating the probability of land abandonment $P_j = \sum w_i * s_{ij}$ P_j probability of land abandonment at the parcel j w_i weight of factor i s_{ij} value of factor i at the parcel j						
Output							

Figure 2: Concept of a GIS-based model to assess the probability of future land abandonment (PROBAT)

Considerations on costs and benefits of PROBAT

Developing and implementing a GIS-based instrument such as PROBAT leads to some information-economic questions:

- What are the costs for developing, running und updating this instrument?
- Who will probably use PROBAT and what are its benefits?

Like each IT-application PROBAT consists of data, hardware, software and know-how. For each of these components specific costs (material, staff and services) have to be considered (see table 1). PROBAT mainly uses existing data to generate new information. This is a quite cost saving method if existing official secondary data are provided for free by the data holder (no macro-economic costs arising). Otherwise data acquisition will probably amount the main part of the expenses. Personnel and data costs also depend on the model design and on the extent of the study area.

Table 1: Costs of developing and implementing PROBAT

types of costs	costs	depending on …
personnel costs		
	▪ development of the modelling concept (research project) ▪ feasibility study ▪ transfer to practice	▪ extent of the model, i.e. number of included variables (data sets) ▪ qualification of the staff
	▪ surveying of primary data (own survey of special socio-economic data and individual attitudes) ▪ data input and statistical examination of primary data	▪ type of model (including socio-economic data and individual attitudes or not) ▪ opportunity to derive these data from existing data (proxy variables) ▪ extent of study area (municipality, cadastral municipality, selected parcels) ▪ number of holdings
	▪ data processing and data management preparation of secondary and primary data limitation of data to study area GIS-integration of the data transformation to parcel level combination of data sets generating new data sets form existing data calculation of occurrence probability visualisation of the results	▪ number of variables (data sets) included in the model ▪ qualification of the staff
material costs		
data	▪ existing official secondary data digital elevation map digital soil map digital cadastral map and real estate data data of IACS data of Agricultural Structure Survey	▪ user (free access to official data or not) ▪ number of variables (data sets) included in the model ▪ data holder (charges or over-all provision) ▪ extent of study area
	▪ data updating	▪ time period of data updates
software	▪ GIS software incl. extensions for spatial analyses ▪ database software ▪ statistics	▪ already existing (probable) or necessity to buy or lease ▪ capability of the software ▪ opportunity of outsourcing
hardware	▪ GIS suitable PC ▪ data storage media ▪ printer or plotter	▪ already existing (probable) or necessity to buy or lease ▪ capability of the hardware ▪ opportunity of outsourcing
costs for services		
	▪ external knowledge (e.g. consulting services for technical problems) ▪ costs for trainings (schoolings)	▪ make or buy decisions ▪ already existing GIS knowledge within the user institution
	▪ travel costs (surveying) ▪ costs for accommodation ▪ phone costs (if phone interviews are adequate) ▪ plotting costs	▪ necessity of an own survey ▪ opportunity of outsourcing

For evaluating the benefits of PROBAT in a reliable way a "market analysis" (information requirements, utilisation opportunities, material and immaterial benefits) would have been necessary. As the model is currently under development a survey estimating the benefits is

not appropriate at this point of time. For this reason a pragmatic approach was chosen by assuming potential users (summarized by different stakeholders) and benefits of PROBAT (see table 2). Some benefits can be measured monetarily (material benefits), others can hardly be quantified (immaterial benefits). The integration and comparison of existing information which is sometimes only observed in an isolated way will be a main general benefit of the PROBAT.

Table 2: Potential users and benefits of PROBAT

stakeholders	potential users (institutions)	benefits of PROBAT	
		ıaterial benefits	nmaterial benefits
agriculture	▪ inistry of Agriculture ▪ ustrian Market Organisation and Intervention Agency ▪ hambers ▪ and consolidation authorities ▪ iomass converters ▪ armers	▪ focussing of agricultural and landscape preservation subsidies (only supporting those parcels where land abandonment is undesirable)	▪ basis for systematic reduction of agricultural land to reduce surpluses ▪ information about locations of potential future biomass resources and development of adequate measures to convert biomass ▪ information basis for decision making in set-aside management
land use and landscape planning	▪ ustrian Conference on Spatial Planning ▪ ustrian Institute for Regional Studies and Spatial Planning ▪ unicipal spatial and land use planning ▪ rivate planning offices	▪ development of cost saving landscape maintenance concepts (by only maintaining selected areas) ▪ development of more appropriate and locally different measures to avoid land abandonment ▪ cost saving purchase of land for municipal purposes (relatively low priced non used agricultural parcels) ▪ easier and more efficient search for ecological compensation sites	▪ basis for developing local policy guidelines ▪ estimating local land use scenarios and basis for reacting on undesired development
forestry	▪ orestry institutions ▪ orestal planning offices ▪ iomass converters	▪ more efficient use of subsidies for afforestation (avoidance of windfall gains)	▪ simplified finding of sites for planned afforestation and natural afforestation
nature conservation	▪ epartments of nature conservation ▪ ational park and nature park administration ▪ rivate nature conservation institutions	▪ cost savings at developing biotope network systems and semi-natural areas because of simplified supply of adequate land ▪ avoidance of misinvestments (no subsidies for parcel that will be probably abandoned anyway)	▪ easier identification of rare valuable habitats (e.g. semi-arid habitats, wetlands) which are depending on agricultural use and development of adequate measures to maintain agricultural use on these habitats ▪ simplified development of secondary wilderness and nature experience areas
tourism and leisure industry	▪ ourism and leisure administration and planning	▪ simplified finding of leisure sites	
science	▪ and use research ▪ allow research ▪ gricultural sciences		▪ basis for further research on set aside management, land abandonment, forest expansion, landscape aesthetic aspects etc.

DISCUSSION

A literature screening showed that hardly any paper about GIS-based land use change models concentrating on agriculture (e.g. KUHLMANN et al., 2002; BEBI and BAUR, 2002; THORNTON and JONES, 1998; VERBURG et al., 2002) addresses cost-benefit-considerations of such a model. However, when developing PROBAT some marginal benefit aspects should be considered. A higher degree of information (knowledge about as much influence variables as possible) tends to lead to more reliable results of an information system, i.e. a lower level of uncertainty. But an increased level of information also causes higher costs for information acquisition (more data sets, necessity of surveys). Modifying PROBAT by only using secondary data (no surveying of specific socio-economic data and individual attitudes) potentially will save costs and time. But it has to be proved whether such a modification will lead to a more imprecise probability assessment. Or vice versa: Are the additional expenses of an own survey (costs for staff, travelling and accommodation) economically justifiable, i.e. is the explanatory power of the results significantly higher and do the additional benefits exceed the additional costs?

The availability of secondary data is another central aspect when developing and implementing a GIS-based model. Legal constraints for using official data, e.g. protection of data privacy, make GIS applications sometimes difficult. Allowance to use and to combine official data sets has to be clarified. Finally technical feasibility (GIS capability of the data, integration of the data sets) and transferability of the model to different regions (validity, calibration of the model) have to be taken into account.

OUTLOOK

Efficient rural development needs information about land use changes. In future data quality (precision, scale level) and data quantity (area-wide, new data sets) but also technical performance of Geographic Information Systems (software and hardware, interoperability of GI-Systems) will probably rise. E.g. the opportunity to use GIS data of IACS (Integrated Administration and Control System) would enhance the potential for agricultural land use analysis and forecasts. Better linking of existing data, data improvements and advanced methods probably enhance the information quality about ongoing and expected land use changes. Nevertheless further effort must be spent creating new methods and collecting better data to build an information framework that meets the users' requirements and that can be adopted to an operational setting.

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