ASSESSMENT OF 'NON MONETARY VALUES OF LAND' FOR NATURAL RESOURCE MANAGEMENT USING SPATIAL INDICATORS

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Key words: Valuation of Land, Non Monetary Values, GIS, Remote Sensing.

ABSTRACT

In the paper the different functions of land, which include social, economic and ecological issues are summed up in order to improve the understanding for different interests and different views on the importance and value of land. The traditional valuation of land in Austria, which is mainly based on economic parameters, is outlined. The main drawbacks of theses traditional valuations are discussed and possible solutions scenarios for the assessment of social and ecologic values of land are presented. The integration of these values in a comprehensive valuation model is demonstrated using practical examples from social and ecological studies carried out.

1. INTRODUCTION

The main objective of politics in land management is the „optimal use" of land. But how is this optimal use defined? Should land be used optimally in an economic way, in an ecological way or in a social way? The definition of the "optimal use is dependent on regions and time. So in Central Europe the land management gave priority to agricultural productivity to secure the feeding of the population. Thirty years later the ecology of land won on importance and now land management in Central Europe focus their strategies also to social aspects.

Political authorities (governments) have the possibility to control the use of land with different measures of land regulation (e.g. taxation, subsidies, expropriation) – of course within a defined legal framework. International Organizations (UNCHS 1996, UN 1993) define the global strategies for „optimal land use".

Land administration institutes and also the scientific community have to support the decision makers with excellent models and scenarios in land management based on objective and comprehensible data. In general there is no problem by describing land by geometric and chemical data. Surveyors and soil experts are very skilled to access geometric and analytical details of land and soil. The economic value of land is market-driven in cases of changes of land property rights. This focus on monetary value can also be seen in the taxation systems.

The characterisation of land in an ecological and/or in a social way becomes more and more important. The paper demonstrates some possibilities to valuate the social and the ecologic value of land by using Earth Observation data and Geographic Information Systems (GIS).

From an economic point of view the value of land is expressed in monetary value based on a limited number of parameters. To incorporate special social and ecological functions and to guarantee rights on or benefits of the single parcel for the public mostly restrictions on land use are implemented. But mostly these social and ecological functions of land decrease the monetary value of land due to the restrictions of property rights of land.
One of the problems that have to be solved is to define a social and ecological value for each single parcel. Until yet no tools for assessment of social and ecological values of land exist. In addition the lack of thematic data on these parameters caused that these parameters were almost neglected in assessing the monetary value of land parcels.
The current situation allows integrating these social and ecological values due to the enlarged databases being recorded in the frame of land monitoring systems and the extended knowledge about social interactions of land and ecological functions. Of main importance for the value assessment is the capability of GIS to enable the analysis of neighbourhood interactions and topologic analysis.
Geo-spatial plays a key role as input data for monitoring and evaluating these parameters. Especially in the evaluation of ecological issues the scale dependence of certain indicators cannot be neglected. Earth Observation techniques in combination with Geographical Information Systems provide a useful tool to address both issues: the issue of time and the issue of scale. The main advantage of Earth Observation data is their consistency over time and space in combination with the delivery of objective and comprehensive information based on the measurement of physical properties.

2. FUNCTIONS OF LAND

First of all land is used as living environment. But land also serves as a base to fulfil the various human needs. According to these human needs three main types of land functions can be defined: Economic Functions, Social Functions and Ecological Functions.
Priority setting of functions varies between landowners, land tenures and the public, which often lead to a high conflict potential. The paper focuses on the quantitative assessment of values resulting from these different functions. The discrepancies and possible solutions will not be discussed in detail.

2.1 Economic Functions

Beside capital and labour land is one of the classical production factors of political economy. It can be seen as a product itself or as a mean for producing other goods.

Product: As an article of trade land has some specifics: Firstly, the supply of land is constant within a state. The free-market system does not work for land – unless branches of land markets will be considered. In this case the supply of specific kinds of land can be increased (e.g. the supply of building land can be increased by modification of zoning or by fiscal measures). Secondly, land is not a homogeneous product: Parcels differ e.g. in regional sites, in the degree of existing infrastructure, in soil quality. So each parcel is not fully substitutable.

Production: Land is a substantial part for the food industry. Crop, vegetables and fruits are cultivated on land and land is needed for the stock farming. On the other hand land is a basic necessity of power industry. Land is an essential source and storage for energy resources (e.g. oil, coal, water) and land is the basic for the cultivation of renewable resources (e.g. wood).

2.2 Social Functions

All aspects of land, which utilizes the human beings without any economic benefit, will be summarized as social functions of land. In general these functions fulfil the three basic needs for mankind: food, living, clothing.

Resources Use: The social function of resources use encompasses mainly the by-products of land and parcels. One main by-product is water of high quality. Other examples for the function of land for resources use is the coverage of basic needs for living and working like the collection of fire wood, basic food like fruits and mushrooms as well as the provision of fodder for animals.

Welfare: The welfare aspect includes the function of land to regulate the climate and the water supply as well as the purification of air and water. The function to reduce noise emissions get increasing importance in densely populated areas or areas with a high pressure of transport and traffic.

Protection: Considering the protection function for human beings land has a schizophrenic role: Besides the climate conditions the specific topography of land is the reason for most natural disasters, e.g. avalanches, floods or landslides. On the other hand land preserves people from natural risk – once again due to its specific topography.

Recreation: Recreation is one of the basic needs of human life. The recreation in natural areas plays an important role in social life. The trend of current leisure activities is showing an increase of all kinds of new and different outdoor sports and activities.

Cultural: Land often has for its residents an emotional component. The region of birth often will be seen as homeland. Many of military conflicts in the past and still in the present are caused by claims for regions by different nations.
But land also is an inspiration medium for artist. The beauty or the specific landscape of a region often is the catalyst for the composition of paintings or poems.

2.3 Ecological Functions

The ecological functions of land in terms of climatic change and conservation of natural resources and biodiversity have got increasing attention by the international community (UN 1992; UNFCCC 1992, 1998).
International agreements addresses the requirements necessary for the functioning of ecosystems through the concept of core areas, corridors and buffer zones (UNEP 1996). Core areas, which form the main part of an ecological network, will conserve the

ecosystems, habitats, species and landscapes of international importance. Corridors are essential for the migration of animals and buffer zones support and protect the network from adverse external influences.
The expected global warming has led to strategies and international agreements to reduce the emissions of greenhouse active gasses (UNFCCC 1992).

Climate: In the worldwide discussion of climatic change land resources play an important role either as sinks or sources (IPCC 2000) of greenhouse active gasses as carbon dioxide (CO_2), methane (CH_4), or nitrous oxide (N_2O). Although the United States of America refused to ratify the Kyoto Protocol (UNFCCC 1992) the international community seeks for solutions to tackle the problem of climatic change. The function of land as sink or source are foreseen as one part of the emission trading process and thus have a high importance for the global national carbon budget of the member states (NILSSON et al. 2000).

Biodiversity: The threat to wild species continues to be severe and the number of species in decline is growing (EEA 1995, 1998). In many European countries up to half of the known vertebrate species are endangered. One third of the reptiles, fish and bird species are in severe decline. This decline is primarily due to the deterioration of natural habitats necessary for their survival.
As a consequence of many worldwide, European as well as national initiatives the public concerns and awareness for biological and diversity issues are increasing. Landscape is recognised as a unique mosaic of biotic and abiotic features (for example: cultural, natural or geomorphologic features). It is recognised that the change in land use practices are an important influencing factor for both biodiversity and diversity of landscapes.

Migration: The conservation of core habitats does not consider all the different needs of species. The dispersal and migration of species between their habitats have to be facilitated. Therefore wildlife corridors and are important elements of an ecological network, which are established to improve the coherence of natural systems.

3. TRADITIONAL VALUATION OF LAND

In difference to the UK and many other countries land surveyors do not carry out valuation in Austria. Dependent on the types of values described in the next chapters different professions are responsible for the valuation of real estates. But in all cases the experts must have a licence granted by a public institution.
When speaking about value of property there are different types of valuation depending on the purpose of the valuation (HEIDINGER et al. 2000). For Austria they are outlined in the following sections.

3.1 Types of Values

Market Value: In the Austrian Statute on Property Valuation (Section - paragraph 2) the market value is defined as “the price, which can usually be achieved when selling an item in honest business”. So the Market Value describes the price of property on “the open

market" at the date of valuation. The price is orientated by offer and demand. In the case of land the price is influenced mainly by the parameters zoning and site of the parcel.
In *Section 2 - paragraph 3* of the above mentioned statute excludes *"special likings and other sentimental values attributed by individual persons by determining the market value"*. But as the paid price for a property often is a result of private interests or speculative factors, the market value in general does not correspond to the so-called Selling Value.

Selling Value: The selling value is the price of property appointed by subjective ideas of vendor and purchaser. Of course the Selling Value is the negotiation result of the vendor and the purchaser, whereas the role for each of the persons is clearly defined: the salesman tries to attain the highest price, the purchaser wants to keep the price at a low level.
In general the Selling Value is higher than the market value, but in the case of an emergency sale the price also can lie lower than the market value.

Tax Value: The regional finance offices (tax offices) determine this type of price in accordance with the *Assessment Statute*. The Tax Value of the property is used as basis for land taxation in Austria (land tax, gift tax, inheritance tax, etc.). Only in cases of purchase the land transfer tax is based on the Selling Value.
As the Tax Value is a very simplified valuation of property this value neither corresponds with the Market Value nor with the Selling Value. The Tax Value is the result of a region wide estimation of land neglecting the detailed characteristics of individual parcels at a specific date (SIMON et al 1998).

3.2 Methods of Estimation of the Market Value

The methods for the determination of Selling Value and Tax Value the main components for the valuation of the Market Value are outlined above. Now the three methods for the estimation of the Market Value used in Austria will be considered. The methods are documented in the *Property Valuation Statute.*
For the determination of the market value the expert can choose each of the three methods. In general the choice of the specific method is dependent on the characteristics of the property to be valued, whereas for controlling purposes the market value also can be estimated using the other two methods.

Comparative Value Method: The price of the whole property (land and buildings) is determined by comparison with actually achieved prices of properties with a similar characteristic. The problem of this method is the lack of equivalent parcels. So the deviating qualities must be considered by upward or downward adjustment of the market value. Mainly this method is used for the valuation of land without buildings.

Real Value Method: This Method is based on the determination of the sum of single components, as land value, building value, the value of other irremovable and also movable fixtures, whereas for the estimation of land value the Comparative Value Method is applied. The value of the buildings is based on the production value decreased by technical and economic depreciations.

Income Value Appraisal Method: The Income Value of a property includes the property value as well as the income value of the existing buildings on the parcel. The Income Value is the net income from the property attainable on a long-term basis reduced by the interest amount for the land value. Usual this method is applied for built-on property, where income is or can be available because of letting the property.

4. EXTENDED VALUATION

Considering the traditional valuation of land and the manifold of functions it is obvious that social and ecological functions are underestimated in comparison to the economical functions. The problem lies in the quantitative assessment of the social and economic significance and the transformation of this significance into monetary values.

4.1 Integrated Land Valuation

The general trend that can be observed in the assessment of land valuation is that social and/or ecological values are not integrated in the market value. One common policy to integrate these non-monetary values is achieved with the establishment of restrictions for the land and land management. Restrictions are documented in legal frameworks and express the public interest in social and ecological functions. And these restrictions do have effects on the monetary value. But instead of increasing the monetary value of land with the increase social and ecological value the monetary value is decreasing due to these restrictions.
Considering the impact to the land tenures the effects of social and ecological functions can be quite different: Mostly the land tenure does not benefit from the restrictions based on social needs. Advantages take place either in the near or far surroundings of a parcel or/and the land tenure of these parcels. So the landowners has no directly improved value for his land parcel, whereas restrictions based on ecological considerations (e.g. management restrictions to conserve species in an area; NATURA2000 EU directive) can improve the ecological value of the land itself. However in both cases the economical value as calculated in the traditional manner is decreasing as discussed above.
For an integrated land valuation a two-stage approach is proposed: In a first step the significance of certain land parcels for the different social and ecological functions is quantified. The result of this process is a relative ranking and zoning of parcels depending on the social or ecological characteristics. Examples describing the estimation of these characteristics are given in the next chapter. The second step transforms the relative significance of these social and ecological functions to monetary values. A possible approach could be to analyse the market values of parcels affected by different intensities of existing restrictions. Using the assumption that any regulation that intends to improve either a social or ecological function reduces the market value of the parcel, the decrease of the monetary value is inversely correlated with the (monetary) social or ecologic value. From this assumption a model can be derived.

4.2 Assessment of Social and Ecological Values

One main research topic at the Institute of Surveying, Remote Sensing and Land Information (University of Agricultural Sciences Vienna) deals with the assessment of thematic land attributes with special focus to social and ecologic parameters. The investigations that had been carried out, comprise the following:

- Risk management for the assessment of protection value
- Corridor assessment for wildlife management
- Assessment of landscape structure for estimating biodiversity values.

4.2.1 Risk Management for assessment of protection values

Austria is a country within the Alps. So the living area in Austria is restricted and endangered by approximately 9000 torrents and 5800 avalanches. 1023 of avalanches are potentially affecting settled areas, 141 are potentially affecting railroads and finally 1840 avalanches are potentially affecting road network. Therefore, recognition, registration and assessment of risk-potentials in alpine areas are important precaution tasks to protect human people as well as infrastructure from being damaged by avalanches, landslides and floods. But by the establishment of protection facilities against natural disasters the market value of these parcels, on which e.g. an avalanche barrier will be built, will decrease and the value of the protected parcels will multiply.
For an effective risk management many different data and parameters have to be collected (e.g. terrain data, soil data, hydro geological properties, vegetation, weather conditions), and have to be considered to predict the dimensions of natural disasters or to enable the construction of protection facilities against avalanches, floods and landslides. GIS is used for the storage, analysis, post processing and finally for the visualisation of parameters, data and results of analysis.
The basic concepts of ELBA-SIM – a simulation model for avalanches - is based on hydraulic theory. The simulation model is fully integrated in a GIS-environment and allows the run-out calculation with respect to different weather conditions, snow heights, etc. in a very short time.

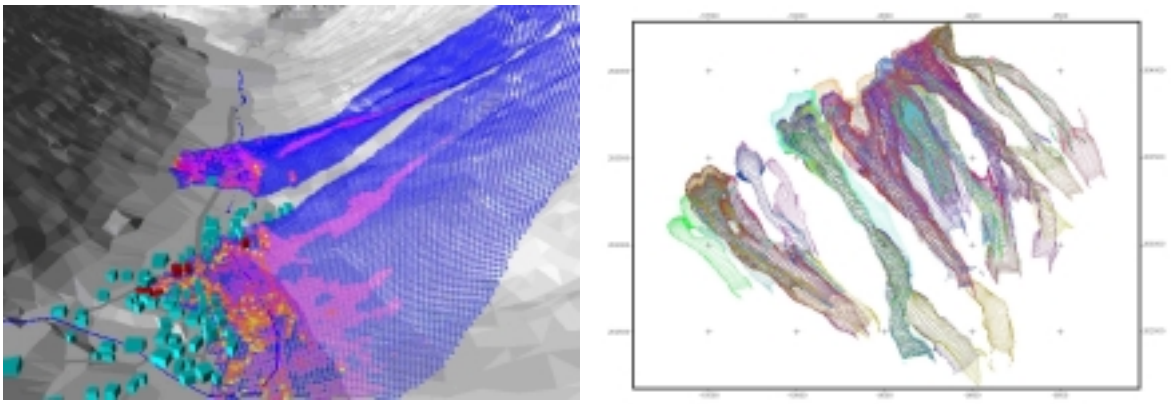

Figure 1: Left image: Area covered by avalanche after 18 seconds (Volk et al. 2000);
Right image: Simulation results for different from start preconditions (Fuchs et al. 2000)

By means of the presented simulation methods the areas of endangerment can be calculated and visualized for long-term as well as for short-term risk management. The "Dynamic Danger Plans" will point out the degree of danger for each parcel. Merging this information with land register and cadastral data the landowners can be determined.
During the planning phase for protection facilities the risk process also can be merged with the data of cadastre and land register to evaluate the decrease of risk for relevant parcels. As the improvement of protection of parcels is related also to an increase of the parcel value, the owners of involved parcels can be forced to contribute to the building costs – directly or by taxation

4.2.2 Migration of Animals

Biological corridors can be compared to lifelines for animals. They establish a connection between habitats and enable animal dispersal. Such dispersal becomes important for the species and genetic interchange. The long-term survival of migrating species is dependent on the availability to cross the landscape trough corridors. Mostly these biological corridors are unprotected and vulnerable to development activities. They have a high value for wildlife and therefore a high ecological function (GRILLMAYER et al. 2001).
Corridors as defined from a biological perspective can be assessed using state-of-the-art technology. The collection of data, which accurately represents the vegetation and topography of the landscape, is available through the classification from satellite images, aerial images as well as information from digital terrain models. With such models the bottlenecks, gaps, or obstacles, which would hinder the movement of each species can be pointed out. *Figure 2* illustrates the zoning due to the importance of land as a migration route for red deer in a test area in Austria, east of Vienna, which is part of a major European wildlife corridor. The value of land for migrating species can be quantified using GIS data and the expert knowledge of wildlife biologists.

4.2.3 Biodiversity Assessment

For assessing ecological functions like biodiversity there is a strong need to define and provide a standard set of criteria, indicators and methods utilising Earth Observation data and Geographic Information System for the assessment and monitoring of terrestrial landscapes. To address this issue a methodology has been developed (BANKO et al. 2001) which effectively combines modern and advanced image processing techniques with landscape ecological approaches.
Spatial indicators are very helpful tools to characterize landscapes - according to aspects of nature conservation. With such indicators, like edge density or mean size of landscape elements, a comprehensible evaluation of land can be achieved (Figure 3). Such an evaluation is important to ensure the development of strategies for sustainable regional development.

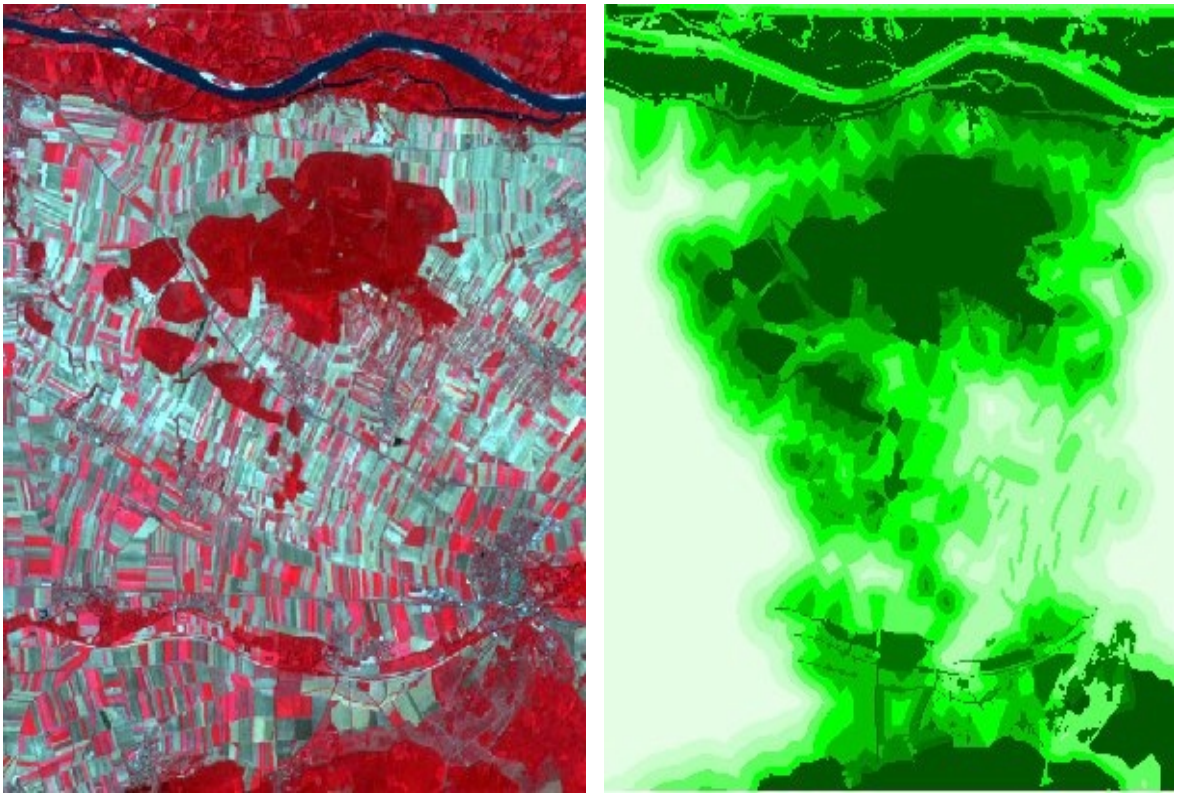

Figure 2: Landsat TM satellite image of an 15*20 km2 test area (left image); zoning of areas in terms of significance for wildlife movement (right image); the ecological migration value ranges from very high (dark green) to very low (light green). Dark green colours represent areas of high value for red deer migration.

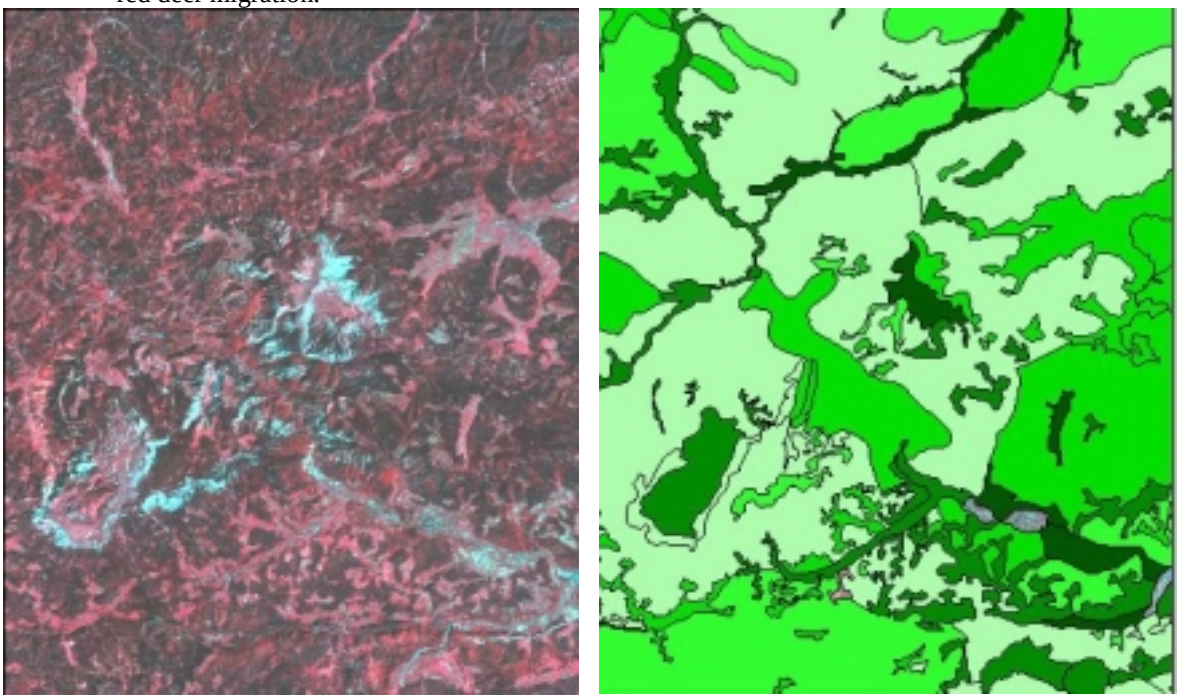

Figure 3: Landsat TM image of test site in Austria (left image); zoning of areas in terms of nature conservation, where dark green reflects the highest level of biodiversity (right image).

5. CONCLUSION AND OUTLOOK

The paper demonstrated different methods to assess the value of land for economic, social and ecological aspects. Although quantitative models to assess the social and the ecological value are available – as outlined by some examples – the awareness for these values is not yet reflected in monetary assessment methods of properties.
It is important to mention that the priority of the different aspects of land is not stable over time. The zeitgeist as a result of social development is responsible for the alteration of priorities over regions and time. And this change of zeitgeist also must have an impact on land administration issues. Politicians have to make the decision about the weightings between economic, social and ecological values, which reflects the optimal use of land for a specific period in time - as discussed in the introduction. Land Managers and Land Administrators are urged to provide fundamentals for decision-making.
The current trend that can be observed in Central Europe shows an increased importance of social and ecological values. Therefore the demand on new land value assessment methods is growing.
It is a challenge for politicians to guarantee the optimal use of land. And it is a challenge for the scientists to work on quantitative and comprehensive models to define the optimal use of land.

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BIOGRAPHICAL NOTES

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