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The *Multifunctional* Use of Landscapes

Some thoughts on the diversity of land use in rural areas of Europe

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Introduction

One of the peculiarities in land-use and land-cover modelling is the great attention that is still given to agriculture and forestry. While it is obvious that these economic activities play a dominant role in the land-cover change of *agricultural* areas and *commercial forests*, this is certainly not the case in many other landscapes. Especially in Europe, but also in many densely populated countries of Asia, we have large landscapes, which are shaped by driving forces that are basically *unrelated* to the traditional sectors of agriculture and forestry.

There is, for instance, the largely unmanaged, semi-natural land in the Far North (Northern parts of Scotland, Sweden, Norway, Finland, and Russia), the high Alpine Mountains, or the peripheral regions in the North-west of Spain and in the North of Greece In some parts of these areas the land cover might be affected by animal husbandry (elks, cattle, sheep, goats), but the main drivers that affect these lands are bio-geophysical and climatic conditions. At the other extreme we have significant land areas in Europe (and Asia), which are used for (semi-) urban, industrial, or infrastructure purposes, which have nothing to do with agriculture and forestry. The land-use footprint of our modern, urban societies is mainly determined by *non*-agricultural (and non-forestry) landscape functions. These functions include, among others things, provision of residential and recreational space, areas for industrial production, for resource extraction, and for energy generation, as well as land used for transportation networks.

In a different context I have shown that land-*use* statistics are often rather biased, because they typically include large natural or semi-natural areas, which are only managed in a very rudimentary way or not at all (Heilig, 1996). Of course, we can also experience land-*cover* changes in these areas, but these changes are either driven by *non*-anthropogenic bio-geophysical factors or by *indirect* impacts of our modern, industrial world, such as effects of climate change. These indirect impacts, however, have little to do with the *use* of land. They are the results of industrial production, mass-consumption and modern lifestyles primarily in *urban* areas.

In other words: land-use and land-cover modelling for Europe has to take into account primarily *urban* sectors and consumption patterns, as well as the systems of production and transportation, which are supporting the urban-industrial world. The focus on agriculture and forestry is misleading. We are not in the tropical rainforest, where agricultural expansion and slash and burn farming are major factors of land-cover change! Natural land or previously unused areas in Europe are not declining due to agricultural expansion, but as a result of structural changes in modern industry, infrastructure construction and (sub-) urbanization. In its Report on the "Environment in the European Union at the Turn of the Century" the European Energy Agency acknowledged this primarily urban-industrial driving forces of land-use change in the Chapter on "Land use footprints" (EEA, 1999, 69 –77), which included extensive discussions and data related to the "pressures of urban areas and transportation networks", the expansion of "built-up land in river catchments", and on land cover changes in densely populated coastal areas.

Multi-functional land-use and land-cover modelling

A balanced modelling approach to land-use and land-cover would include the following steps:

1. Identification of the *dominant landscape functions* for the urban-industrial society
2. Definition of empirical *indicators* for these functions
3. Specification of the *interdependencies* between various landscape functions
4. Selection of a modelling *framework* for these interdependencies
5. *Development* of the model

In Europe the land is used in many different ways. Other than in *traditional* societies, where most of the land is either (semi-) natural or used for agriculture and animal husbandry, modern societies typically use land for many different purposes. This does not only include production-related land-use (such as in agriculture and forestry), but also a whole range of land-use types related to the economic service sectors (such as tourism, recreation, sports). Accordingly, the driving forces of these land-use types are linked to economic demands, but also to consumption patterns and lifestyles. In Table 1 I have listed various land-use types. They are also organized according to the sector for which they are most relevant. This table is certainly not complete, but it gives a first impression of the great range of land-use functions in a modern, industrial society.

Table 1: Multi-functional land-use types in modern societies

Land-use function	Subtype	Sector / Purpose
Agriculture	Food (Grain, Livestock)	Production
	Fiber / Industrial Crops	Production
	Energy Crops / Biomass	Energy generation
Forestry	Biomass for paper industry / Pulp	Production
	Log wood / Construction material	Production
Tourism	Ski slopes / golf courses / race tracks	Services
	Natural monuments / aesthetics	Cultural values
	Tourism-related infrastructure (tracks, huts, hotels, etc.)	Construction
Transportation	Physical structures (roads, railways, airports, power lines, pipelines, etc.)	Construction
Energy generation	Space for energy generation facilities (wind generators, power plants, hydro-electric stations	Construction
	Space for fuel production (Oil fields, open pit mines, biomass plantations, etc.)	Production
Waste disposal / Sanitation	Solid waste dumps	Services
	Water treatment facilities	Services
Freshwater supply	Water shed areas	Services
Preservation	Landscape preservation (national parks)	Cultural heritage
	Protection of valuable ecosystems	Nature protection
	Protection of rare species	Nature protection
	Prevention of ecosystem fragmentation	Nature protection
Extraction of natural materials	Gravel pits, quarries,	Physical resources
Urban	Residential areas	Housing
	Commercial areas (shopping centers, business districts, office buildings)	Housing
	Recreation and leisure (stadiums, tennis courts, parks)	Housing
Industry	Factories and related infrastructure	Industry
	Storage facilities / industrial dumps	Logistics
Real estate	Land development / Financial speculation	Investment / Finance
	Security	Investment / Finance

The next step in the development of a multi-functional land-use model would be the definition of empirical indicators for the various land-use functions. The value of a certain area of previously unused land, for instance, *greatly* differs, whether it will be used for grain production, for building a golf course, for designating an ecosystem reserve, or for building a suburban housing project. In an urban-industrial society the value of land is *not* (primarily) determined by its intrinsic biophysical *characteristics*, such as soil quality or the amount of rainfall this land receives. It rather depends on the *functions* it might have for a particular economic sector or group of people. In other words: economic, social, and political factors determine the use of land much more than bio-geophysical characteristics. Land-use models that are based on bio-geophysical characteristics of the land are therefore inappropriate for modern societies.

The problem with socio-economic models of land-use is the enormous complexity of inter-dependencies. We have great experience in calculating the *quality* of land for agricultural purposes based on chemical, physical and organic soil characteristics, terrain features (such as steepness and soil depths), average conditions in precipitation, temperature and sunshine duration, etc. But these calculations are largely irrelevant if the land could be used for an oil refinery or an open brown coal pit mine. The problem with modelling land-use in a modern society is that we have to compare various land functions without having a comparative criterion. A piece of land may have zero value for grain production (because of the infertile soil or the lack of water), but it may be immensely valuable for a residential area, because it is located at an urban fringe.

If we would only use the market value of land for modelling land-use change, we would end up with very little space for habitat protection – particularly in more densely populated areas. Some land-use types are just more likely, if only money determines its use. Fortunately, money is not the only criterion that determines land-use in modern societies. Usually there is a whole range of land-related legislation and administrative regulations – from zoning laws to large-scale regional development plans. These political, legal and administrative conditions must be included in a land-use model, if it should realistically represent land-use in a modern urban-industrial society.

In IIASA's European Rural Development (ERD) project we have started the development of a Rural Analysis and Planning System (RAPS), which combines various demographic, economic, social, political, infrastructure and environmental factors to estimate the *development potential* of a particular area (currently we are using about 1300 Austrian rural and urban municipalities).

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