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Changing landscapes in Northeastern Europe based on examples from the Baltic countries

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Abstract

The landscapes of Europe are the result of thousands of years of human impact. As a product of human intervention in natural processes they have always been changing. The processes of changes in agricultural land use have led, and still lead, to a change in both the biotic and abiotic conditions of the landscape at local, regional and European level. The share of agricultural land is increasing from Estonia towards Lithuania. In the same time, the share of forested areas, wetlands and water bodies is decreasing from north to south. The main trends in landscape changes in the Baltic countries during the last decade are abandonment of agricultural lands, omitting land amelioration and increasing clear-cutting in forests. Farm management as usually practiced in marginal areas has maintained nature-conservation value. However, marginal areas are also affected by agricultural change. As farm units are generally smaller in marginal areas and economic rationalization is constrained by both physical and biological factors, the social and ecological effects of agricultural change are more profound, in scalar and temporal aspects, here than in more productive regions. There is a large excess of agricultural land in all three Baltic countries and more widely, overall in Northeastern Europe. It means that there is no real need for it from an economic point of view. Possibilities to handle this problem are development of formerly drained areas into wetlands or multifunctional development of landscapes. The DPSIR approach can be used to handle complex problems and especially in environmental management, particularly in the abandonment problems in the Baltic countries.

Keywords: Baltic countries; land-use change; abandonment; DPSIR approach

Introduction

The landscapes of Europe are the result of thousands of years of human impact. As a product of human intervention in natural processes they have always been changing. Both intensive and extensive land uses are expressed in the structure of the land, the size of the parcels and the area of natural and semi-natural vegetation that is present. Landscapes have always been adapted to changing needs and evolving technologies. Both population development and changes in land use have a wave-like character, dependent on the most relevant socio-economic evolution and also on smaller spatial–temporal fluctuations throughout the regions. Likewise, we can find

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common trends, similarities and differences in land use in all European landscapes today.

The processes of changes in agricultural land use have led, and still lead, to a change in both the biotic and abiotic conditions of the landscape at local, regional and European level. A degradation of landscape diversity into rather monotonous and uniform areas of intensive agriculture and development of wilderness areas on abandoned land are the results of recent policy on the European landscape (Van Mansvelt and Van der Lubbe 1999). Uncontrolled set-asides and single-species reforestation at former agricultural lands lead to a loss of diversity. In many cases intensification of land use in one area causes marginalization in other areas. Marginalization is a process that is also a part of man's history and as common as population growth and the development of villages and towns. In forested areas, especially in Eastern Europe, the changes are rather different in comparison with agricultural areas. These are characterized by very intensive clearance, which is, at least in some areas, illegal or not regulated by any plans.

In general, Europe's border has changed rapidly since 1989. The vanishing borders within the European Union (EU) and the activities in the Newly Associated States (NAS) have resulted in intensive landscape changes. These changes are characterized partly by industrial agriculture and partly by less intensive use of agricultural lands that began with the EU agricultural policy in the 1980s and with the collapse of collective farming systems in central and Eastern European countries and the countries of the former Soviet Union since 1989. This tendency has significant socio-economic and ecological results. For instance, abandoned agricultural land will be transformed into forest or industrial/settlement areas, resulting not only in profound changes in employment and the social structure of the rural population, but also in a series of secondary successions that will in turn bring about great changes in biological and landscape diversity. In central and Eastern European countries the rapid collapse of collective and state farms has adversely influenced rural life and development, and many marginal areas became abandoned. Ongoing privatization of land in central and Eastern European countries is a source of conflicts between private ownership and nature conservation (Sepp et al. 1999). The stability and semi-natural conditions of many coastal zones, formerly forbidden areas, are now being intensively altered. The big 'support' for these activities is changing land ownership, which is more powerful than weak legislation for nature conservation. This is one of the most important obstacles in the reorganization of the nature-conservation system in central and Eastern Europe. The restoration of ecosystems (e.g. wetlands, river valleys, lakes, damaged forests, abandoned agricultural land, former mined areas, military bases) helps to protect biodiversity and to recover valuable landscapes. All these changes are closely related to the nature-conservation policy that also has new momentum due to the Convention on Biological Diversity, the EU Species and Habitats Directive and the Pan-European Strategy on Biological and Landscape Diversity.

The main aim of this paper is to characterize main trends in landscape changes in Northeastern Europe, based on the example of three Baltic countries: Estonia, Latvia and Lithuania. We consider the DPSIR approach (EEA 1998) and the marginalization–intensification relationship analysis as important methodological tools for studying landscape change. The landscape analysis will be related to landscape functions, which reflect the main requirements of the society (Bastian and Schreiber 1994).

Main trends in landscape change in the Baltic countries

Generally speaking, the Baltic countries are located in a wide transition zone from boreal forested areas in Finland and Russia to more agriculturally used areas in central and Eastern Europe. Respectively, the share of agricultural land is increasing from Estonia towards Lithuania. In the same time, the share of forested areas, wetlands and water bodies is decreasing from north to south. This is easy to see on the CORINE land-cover map, which is the base for many environmental and landscape classifications and analyses in the Baltic countries (Figure 1).

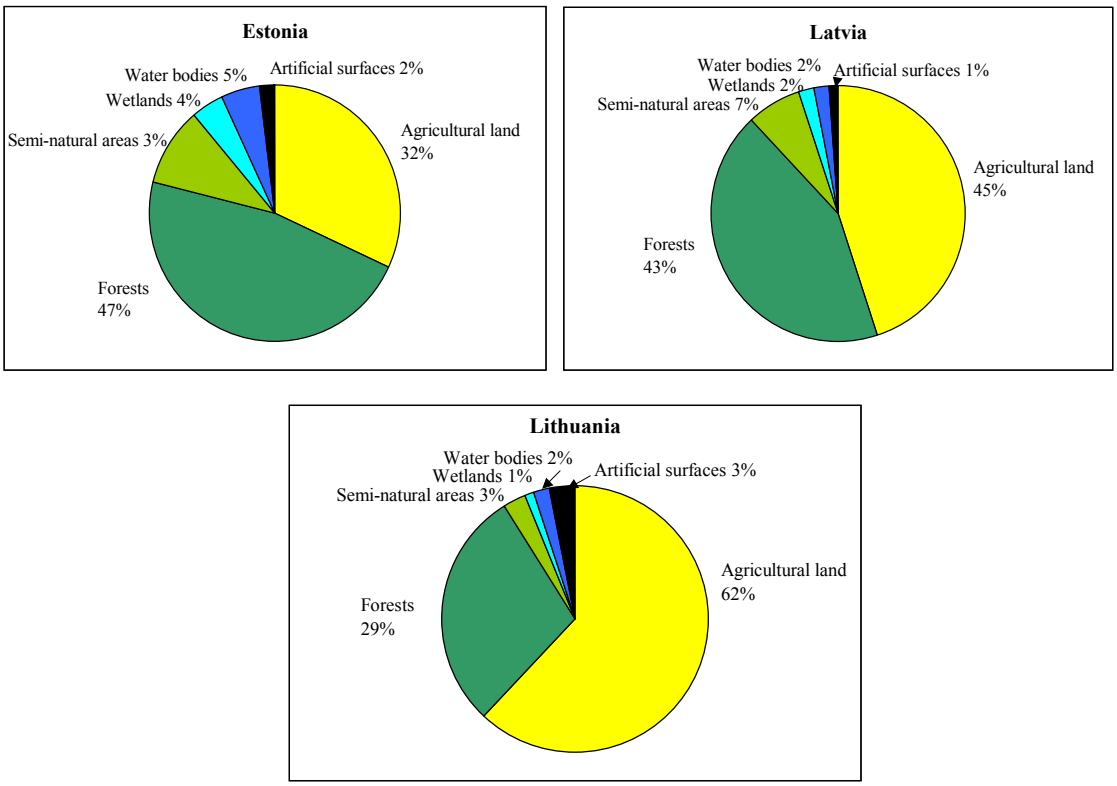

Figure 1. Land cover in three Baltic countries (% of country's territory) (adopted from Baltic Environmental Forum 2000). Semi-natural areas include scrubs and/or herbaceous-vegetation communities as well as open space with little or no vegetation. Wetlands according to the CORINE classification mean only those without trees, otherwise they are classified as forests or semi-natural areas

Main trends in landscape changes in Baltic countries during the last decade are presented in Figure 2. It shows that abandonment of agricultural lands, omitting land-amelioration activities such as drainage and increasing clear-cutting in forests are the main trends of change (Figure 2C). In the same time, additional landscape-protection areas have been established in Latvia and Lithuania (Figure 2). Land abandonment has been the major problem in the landscape during the 1990s. The political changes at the beginning of the decade struck the rural population most, and (temporary) abandonment of agricultural land has been the reaction to the socio-economic changes. The situation was worst in 1995-96, when the share of unused agricultural land exceeded 25% of all agricultural land (Figure 2A). In recent years the amount has slightly decreased or stabilized as the present ownership situation is slightly stabilizing. At the same time, more intensive use of forests can be seen in recent years. The clear-

cutting areas are rapidly increasing in Estonia and Latvia. In Lithuania, where the share of forests is smaller, the clear-cutting has been stable recently. In Estonia the felling of forests of about 15 million m^3 a year exceeds the ecologically and economically acceptable limit by almost 100% (Figure 3). In some forest-site types old-age forests are disappearing (Kuuba 2001). The cutting activities have mainly been concentrated on the very specific forest-type group – Fresh Boreal (meso-eutrophic) spruce forests. According to Kuuba (2001), already half of all privatized meso-eutrophic spruce forests and 38% of all meso-eutrophic forests that were given to new owners have been clear-cut.

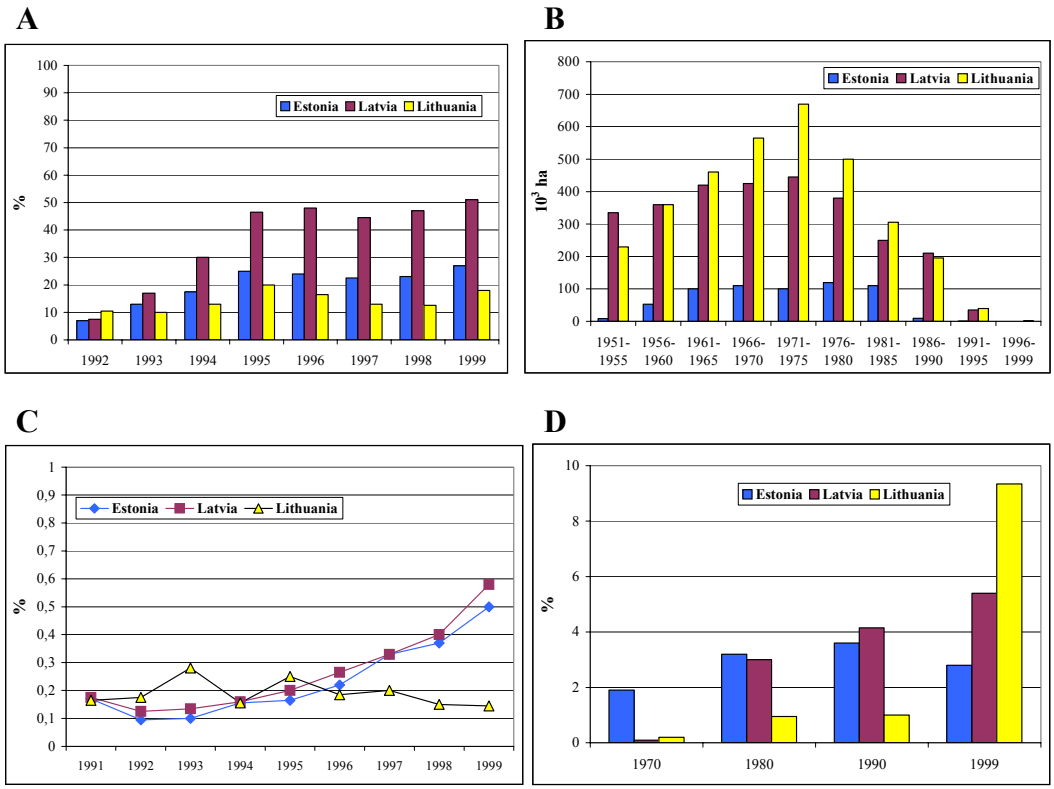

Figure 2. Landscape changes in Estonia, Latvia and Lithuania in the last decades. A - abandoned land (% of arable land); B - area drained in agricultural land (thousand ha per 5-year period); C - area of final felling/clear-cut in forests (% of country's territory per year); D - protected-landscape areas (% of country's territory) (adopted from Baltic Environmental Forum 2000)

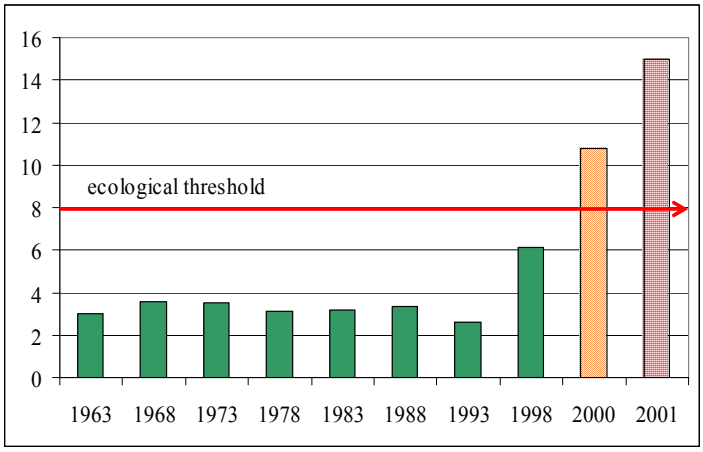

Figure 3. Forest-cutting volumes in Estonia (adopted from Kuuba 2001)

Marginalization–intensification relationship

For most European countries, agriculture is the most important land-use activity influencing the biological and landscape diversity. On the other hand, processes like intensification and marginalization increase the polarization rate of landscapes. Among the 203 threatened habitats in EU countries (i.e. natural habitat types as designated conservation areas), 132 are potentially influenced by intensification and 32 by abandonment of human activities. In the last group 26 habitats are represented by pastures, 5 by grasslands and only 1 by croplands (EEA 1998). In forestry, only intensification threatens the biodiversity. However, abandonment in forested areas can also decrease landscape diversity.

On the other hand, the currently existing system of nature-conservation areas and the designated network of Areas of Special Conservation Interest for Europe (Natura 2000 Network) do not coincide well. One of the solutions in covering both of these systems is the implementation of the Pan-European Ecological Network that also overwhelms the buffer zones of protected areas and connecting corridors (Mander and Jongman 2000).

In many rural societies, interdependent social, economic and cultural changes over the past 50 years have led to significant changes in types of rural land use. Farm management as usually practiced in marginal areas has maintained nature-conservation value. More than 50% of Europe's most highly valued biotopes, for example, occur in low-intensity farmland. However, marginal areas are also affected by agricultural change. As farm units are generally smaller in marginal areas and economic rationalization is constrained by both physical and biological factors, the social and ecological effects of agricultural change are more profound, in scalar and temporal aspects, here than in more productive regions.

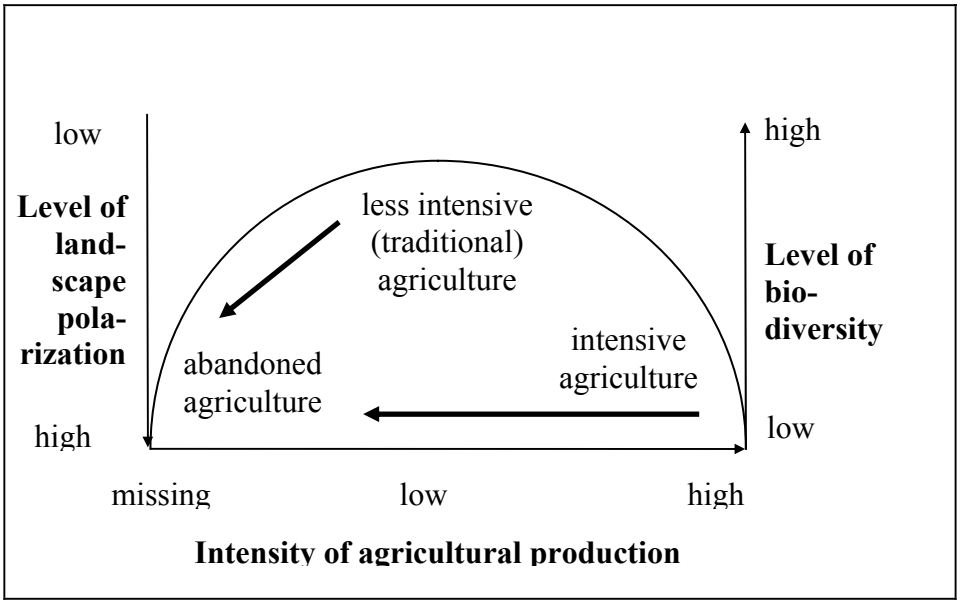

Figure 4. Relationship between the landscape polarization and intensification and biodiversity in rural areas (adopted from EEA 2001). Bold arrows indicate the process of marginalization (land abandonment), which is the dominating trend in the agricultural areas of Northwestern Europe

Table 1. Potential impact of intensification and marginalization on landscape functions in agricultural areas (adopted from Bastian and Schreiber 1994). +++: very strong positive impact, ++: strong positive impact, +: weak positive impact, 0: neutral (no impact), –: weak negative impact, ––: strong negative impact, –––: very strong negative impact

Landscape functions	**Potential impact**	
	Intensification	**Marginalization**
PRODUCTION (ECONOMIC) FUNCTIONS		
Availability of renewable resources: plant biomass		
agricultural suitability: cropland	+++	–––
agricultural suitability: grassland	++	–(–)
agricultural suitability: special cultures	–/+	+/-
forestry (wood biomass)	+/–	+++
short-rotation energy wood	++	–– (?)
Availability of renewable resources: animal biomass		
livestock	+++	––
game	––	+++
fish	+/-	++
Availability of non-renewable resources		
water retention, surface water, groundwater	–––	+++
local mineral resources and building materials	––	++
fossil fuels	++	–
REGULATION (ECOLOGICAL) FUNCTIONS		
Regulation of material and energy fluxes		
pedological functions: soil protection, soil capacity to break down disturbing factors	–––	+++
hydrological functions: groundwater recharge capacity, water retention, discharge balance, self-cleaning capacity	–––	+++

of surface water		
meteorological functions: temperature balance, increasing air humidity and evaporation, wind-field influence	–––	+++
Regulation and regeneration of populations and biological systems (biodiversity aspects)		
biotic reproduction and regeneration of biosystems	––	+/–
regulation of organism populations	––	+/–
regulation of pest populations	––	+
maintenance of genetic pool: domestic animals	––	++
maintenance of genetic pool: natural organisms	–––	+/–
LIVING SPACE (SOCIAL) FUNCTIONS		
Psychological functions		
farmers	++	–––
environmentalists	–––	++
Aesthetic functions (landscape scenery)	––/++	––/++
Ethical functions (genetic pool, cultural heritage)	––	+/–
Information function (perception)	––/++	––/++
Function for research and education	–/+	+/–
Human-ecology functions	––/+	++/–
Bioclimatic (meteorological) functions	––	++
Acoustic effects (noise protection)	--	++
Recreational functions (complex of psychological and human-ecological functions)	--/+	++/-

Figure 4 shows a principal scheme of the relationship between the intensity of agriculture, landscape polarization and biodiversity. It is well documented that the biodiversity and also landscape diversity (mosaic of the land-use patches) is highest in the traditional or organic agricultural systems, which are, however, rapidly disappearing from all European areas (Van Mansvelt, Stobbelaar and Hendriks 1998; Mander, Mikk and Külvik 1999). In most cases, marginalization, which can be started from both intensive agriculture and low-input traditional agricultural level, will result in significant biodiversity change. Very often, abandonment causes the decrease in landscape and biological diversity.

Unfortunately, marginalization beginning from the intensive phase does not change through the phase of traditional agriculture related to a diverse and mosaic-rich land-use pattern: loss of biodiversity can be just as high as in abandonment of traditional agriculture (Figure 4). On the other hand, organic and biodynamic agriculture can support and increase both biological and landscape diversity (Mander, Mikk and Külvik 1999).

A major driving force behind vulnerability of rural areas or marginalization of agriculture is economic marginality. In areas marginal for agriculture, agricultural productivity is often low because of climatic constraints, poor soils and poor accessibility of agricultural lands or traditional low-input agriculture. Food production not only depends on environmental constraints but also on human choices, credit available to farmers, farmers' education, infrastructure, international politics and markets and culture (ECNC 1994).

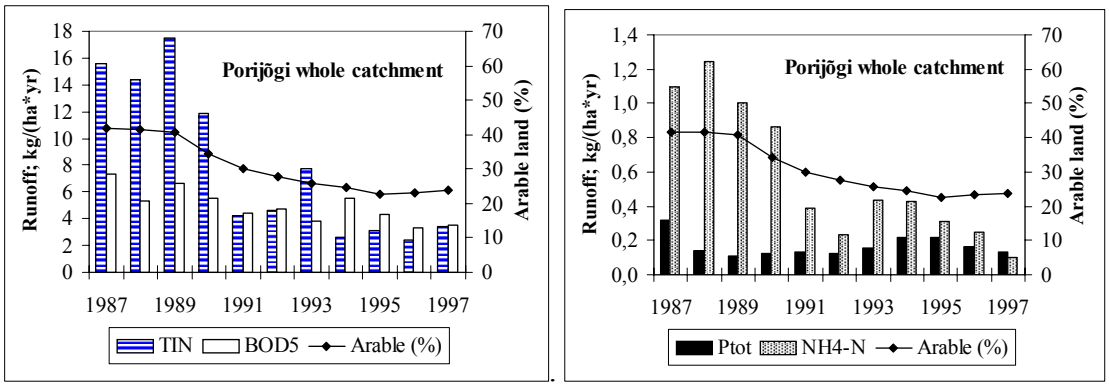

Figure 5. Change of arable land (%) and variation of total inorganic nitrogen (TIN; sum of NH_4-N, NO_2-N and NO_3-N) and total-P runoff (kg ha^{-1} yr^{-1}) in the Porijõgi River basin in 1987-97 (adopted from Mander, Kull and Kuusemets 2000)

We assume that one of the possibilities to develop insight into the marginalization–intensification problem at the landscape level is to consider it regarding the main functions of landscapes (Bastian and Schreiber 1994). Table 1 gives an overview of the possible influences of intensification and abandonment on various landscape functions. Conclusively, intensification of agriculture has a dominant negative effect on regulation functions of abiotic factors (water, soil and air quality), but supports productivity and many social functions. For instance, due to dramatic decrease in agricultural intensity in Southern Estonia, the loss of nitrogen and phosphorus from rural catchments has been significantly decreasing, being at the level of natural catchments (2-3 kg N ha^{-1} yr^{-1} and 0.1-0.2 kg P ha^{-1} yr^{-1}; Figure 5). Regarding biodiversity, the impact of marginalization can be positive (if additional semi-natural habitats will be formed due to secondary succession in formerly abandoned lands) or negative. The latter one is dominating in agricultural areas of Northeastern Europe, where there are still traditional low-input agricultural areas, which will be covered by bushes or young forests in 3-5 years after left set-aside. There is a large excess of agricultural land in all three Baltic countries and more widely, overall in Northeastern Europe. It means that there is no real need for it from an economic point of view. Different policies varying from afforestation to recultivation have been proposed to tackle this problem.

One of the possibilities to deal with marginalization is to turn formerly drained areas into wetlands, which can be used in biomass production (willows, cat-tail, reed) or covering buffering functions of landscape (Mander et al. 2001).

Another way to tackle the marginalization problem is the multifunctional development of landscapes (Sarapatka and Sterba 1998; Tress et al. 2001). In a report on EU enlargement it was highlighted that the European agricultural model's multifunctional character is an essential feature for EU enlargement (Brouwer, Baldock and La Chapelle 2001). While there are pronounced differences among the candidate countries in the level of production, some of their farming practices display desirable characteristics in terms of their limited impact upon the environment or as a part of multifunctional enterprise. Although in the past measures have been suggested to strengthen the use of agro-environment schemes, those areas that face the greatest problem of abandonment deserve our particular concern. Agro-environmental schemes should be economically acceptable, ecologically based and socially fair. Careful evaluation of the various strategies in the EU is needed in order to develop a sustainable balance between food production and multiple needs for lands.

In the process of reorganization of the CAP, ecological and low-intensity agriculture play an important role (Bethe and Bolsius 1995; Van Mansvelt, Stobbelaar and Hendriks 1998). As low-input farming is quite common in areas marginal for agricultural use, the reform of the CAP can play an important role here. Rural development will absorb about 10% of the CAP budget for the period 2000-2006. Several regulations have been developed, such as supporting farmers with subsidies. However, to keep these areas viable more is needed than only subsidizing low-input farming as an option for sustainable management. Sustainable management is based on a multifunctional land-use approach (Van Mansvelt and Van der Lubbe 1999; Xu and Mage 2001). Other ways of earning a farm income than based on providing food, fibre and other agricultural products for human use must be sought. A distinction must be made among farm, regional and international levels (Xu and Mage 2001), and the possibilities for multifunctional land use require study at all levels. The holistic concept of multifunctional landscapes and the need for transdisciplinary goal-orientated landscape research has been presented by Naveh (2001) and Tress et al. (2001) and it is possible to apply this here.

The approach of multifunctional land use to improve viability of marginal rural areas can be made possible by national and international policy decisions, but also strongly depends on local situations. Local situations differ within a country and between countries. Studies on the impact of national and international regulations on the management at local level are needed to gain a better understanding of the local development potential, competitiveness, the diversification of activities and land use, the involvement of local people and the improvement of quality of life and appropriate land use. Not only the analyses but also the syntheses of such studies across a range of countries are needed to explore strategies for appropriate land use based on multifunctionality. Situations may be specific at a local level, but they interact at a higher level. Investigations at the local level can give a feedback on the policy decisions at a higher level.

The DPSIR approach

To get a handle on management of land, basic data have to be translated into ‘factors’, at least qualitative and, depending on the detail required, quantitative (Zonneveld 1995). To get a handle on the current status of land use, on land-use change, the impact of land use on landscape quality and viability of rural communities, agro-environmental indicators have been defined (OECD 1999; Wascher 2000; EEA 2001; Van Mansvelt and Van der Lubbe 1999). The OECD divided the indicators into Driving Forces–State–Response indicators; the EEA into Driving Forces–Pressure–State–Impact–Response indicators. These concepts were taken up in the ELISA project (Wascher 2000) and with regard to sustainability; links between socio-economic driving forces and the environmental state and impacts were defined. In this approach concepts and indicators for marginality for agriculture to develop strategies for appropriate land use were developed (Figure 6). A comprehensive multidisciplinary attitude has been maintained during the analyses and syntheses to facilitate dealing with the complex issues and their interactions

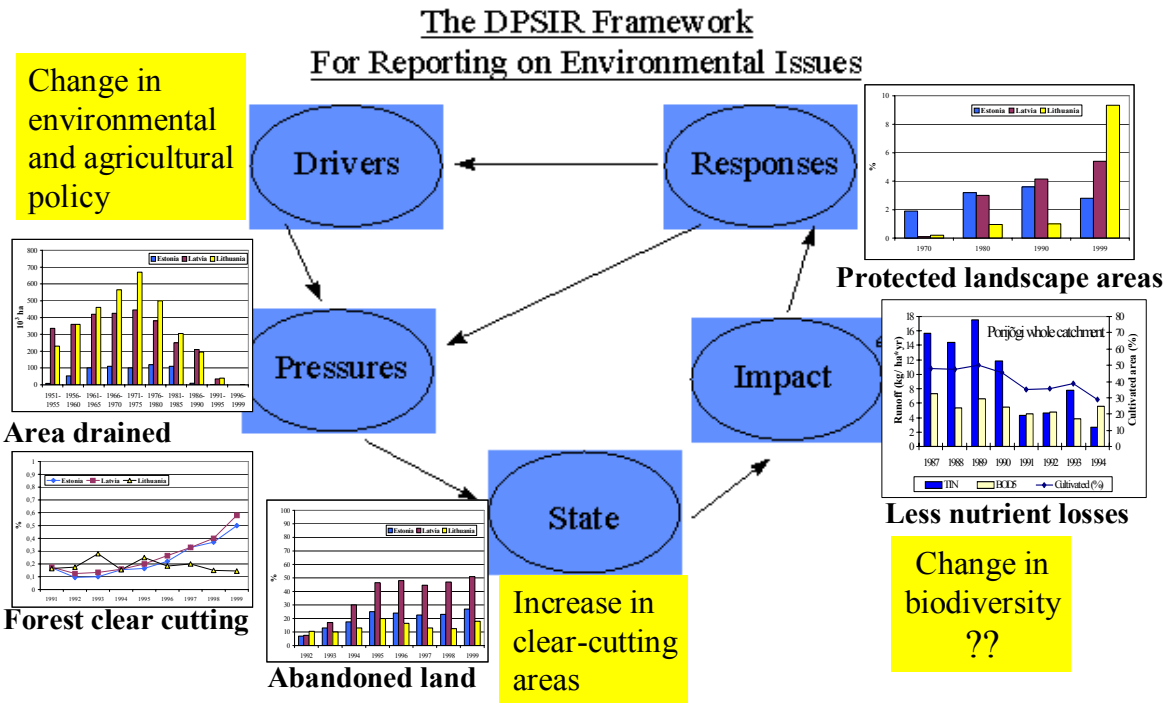

Figure 6. The DPSIR framework for reporting on environmental issues: example of the change in political and socio-economic system in central and Eastern Europe at the end of the 1980s and the beginning of the 1990s followed by the change in environmental and agricultural policy as a possible basis for indicator classification and landscape assessment (EEA 1998; Wascher 2000)

Regarding the EU policy on biological and landscape diversity management (e.g., PEBLDS, The Pan-European Biological and Landscape Diversity Strategy) it is useful to follow the **D**riving Forces (Drivers) → **P**ressures → **S**tate → **I**mpact → **R**esponses (DPSIR) framework for reporting the environmental issues (EEA 1998; 1999; Wascher 2000). This approach treats the environmental management process as a feedback loop controlling a cycle consisting of these five stages. In addition, this introduces the term 'Pressures' and adds 'Impacts' – a concept that implies the cause–effect link.

The nitrogen cycle can be used as an example of DPSIR approach in intensification of agriculture (see also Mander and Koduvere 2003):

Driving force – intensive agriculture

Pressure – use of mineral fertilizers

State – intensive loss of nitrogen from agricultural fields, high nitrogen concentration in rivers and groundwater, intensive gaseous N flux into the atmosphere

Impact – loss of biodiversity, eutrophication of water bodies, methaemoglobinaemia, cancer risk

Response:

a) less mineral fertilizers and optimization of crop rotations with leguminous plants, especially in sensitive and potential core areas
b) establishment of riparian buffer zones
c) establishment of riverine and riparian wetlands.

On the other hand, influence of marginalization (land abandonment) can be also characterized regarding the DPSIR approach (Figure 6):
Driving force – marginalization (abandonment of agriculture)
Pressure – change of existing management scheme
State – loss of open landscapes, loss of various (grassland) biotopes
Impact – loss of biodiversity, loss of landscape scenic values
Response:
a) subsidies for farmers to support the traditional low-input or ecological agriculture
b) restoration and rehabilitation of valuable biotopes (wooded meadows, alvars)
c) (re-)establishment of wetland biotopes in agricultural landscapes.

In both cases, the DPSIR loop can help to handle the complex problems. Therefore, this approach is widely used in environmental management, particularly in Baltic countries.

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