Sustainable Land Use in Intensively Used Agricultural Regions

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Burghard Christian Meyer

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Sustainable Land Use in Intensively Used Agricultural Regions

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12. Bridging multifunctionality of agriculture and multifunctional landscapes by applying the Leitbild approach

Hermann Klug and Peter Zell
(Corresponding author: H. Klug, email: hermann.klug@sbg.ac.at)

Abstract

Multifunctionality is an intrinsic potential of each landscape and at the same time a concept of landscape planning. Embedded in a greater transdisciplinary framework this paper explores many of the aspects of multifunctionality and shows how the concept influences the easing of environmental pressures when applied to landscapes with respect to their vertical and horizontal multifunctionality. While vertical multifunctionality means the possibility of functional superimpositions, the horizontal multifunctionality is dedicate to spatial interconnections. Therefore, a matrix of functional superimposition and a matrix for determination of the necessity of buffer stripes has been developed to spatially explicit advice certain functions. These tools have been integrated in a hierarchical framework. This framework derives spatial explicit zones for land use priority taking into account social and economic values besides ecological ones.

Key words
Leitbild, functional superimposition, buffers, multifunctional landscapes, landscape development

12.1 Introduction

The post-war usage of landscapes focused on intensive agriculture, which caused significant impacts on the environment and laid the foundation to the present days’ surplus food production. The eutrophication of surface waters – among many other effects – indicates in the course of the past decades that the economics of recent agricultural practices need to be changed. Hence, European and national directives, laws and agri-environmental subsidy programs were designed to overcome these problems with the aim to steer the development towards a more sustainable future. Farmers respond to these interventions by introducing changes in farm management leading to e.g. abandonment of agricultural plots, intensification or extensification impacting on diversification, processes, and functions in the landscape. Therefore, bringing landscape planning to the centre-stage does not merely mean to impose disconnected disciplinary actions addressing environmental problems one after another. Moreover, positively influencing landscape development involves policy instruments, funding schemes, business plans, and cultural perceptions of local people.

Generally, in Europe we find both shortages and surplus of agricultural produce. In central Europe, the extension of the urban fringe, housing construction in rural areas, expanding road networks, and progressing industrialisation tends to reduce agricultural land (marginalisation), while the granary of Ukraine with its profitable soils is still expanding its output. However, the recent accessions of new countries to the EU seem to initiate a shift in land use and production strategy towards intensively used agricultural regions in eastern countries and extensification in the non-priority regions. Future planned accessions will intensify this trend, as present favourable climatic conditions combined with low production costs create a more profitable environment than in the western part of Europe. Due to the shifting land use, intensification, concentration, and specialisation are likely to take place in the high productive areas whereas in other regions extensification, diversification, fallow land and dispersion will prevail. The process clearly calls for systematic studies of landscape changes induced by policies which in both cases will influence and are influenced by the different conditions originating from landscapes and their indigenous potential.

Technological development in farming operations yields just another factor transforming agrarian landscapes: plots are arranged according to labour saving aspects causing often monotonous, homogeneous landscapes. While in economic terms, high productive areas are created, the vulnerability against environmental risks increases. The experience made in the past five decades in Western Europe should be transferred to the new accession countries with the aim to avoid the same problems encountered so far.

The main pressure stems from the overuse and overexploitation of natural and fossil resources. Besides the increase in agricultural production beyond the demand, the increasing spatial range for non-productive activities causes an additional pressure on landscapes. These pressures lead to a fundamental change in structure and morphology of the landscape and thereby possibly cause the loss of ecological functions necessary for the health of society. Especially land abandonment with resulting bush encroachment and afforestation in tourist areas is an unwanted phenomenon.

In response to the changing situation, landscape planning needs to integrate social, economic and political aspects with environmental measures to ensure a sound basis for regional planning aiming to ascertain the sustainable maintenance of ecosystem goods and services resulting from functions provided by the natural capital. To conceptualise the multifunctionality of agriculture and multifunctional landscapes under the above prerequisites, a Leitbild approach after Klug (2002)
is extended towards a multicriteria analysis tool (Klug, 2005). This approach uses spatial explicit GIS techniques to develop scenarios framed by a commonly agreed vision for the future state of the landscape – the Leitbild. As most of the spatial planning approaches have a strong focus on ecological science aim at the optimisation of farmland priority zones, the concept proposed bridges socio-economic factors as well as political values and merges them into a semi-operational GIS procedure (Klug in press).

### 12.2 The future of landscape planning

Landslapes are by definition manifold in ecological character, multifunctional in cultural use and highly occupied cultural landscapes which will diversify in the next decades. Due to the fact that landscapes have to fulfil many functions, variations should not pass uncontrolled and ought to be used for social objectives. On the one hand they create economic potential and living areas for all sections of the population; on the other hand they need to provide enough living area for a rich flora and fauna as well as serve among others for recreational activities.

Recent alterations came about from unresolved settlement pressure, fundamental structural changes in agriculture, new ways of recreation (complex of tourism and environment), and upgrading the infrastructure. However, steering development is not as easy, as political decisions are increasingly taken by laymen. Hence, it is very important to develop models, which are transparent and applicable, yielding distinct ideas for future landscape change.

The major challenge for landscape planning today is to master the transition from sectoral thinking to more comprehensive holistic approaches as a transdisciplinary oriented part of landscape ecology representing the contribution to the development of ‘scientifically based and viable Leitbilder which are accepted at least by the majority of people’ (Bastian, 2004). The main problem arises when research is rooted in natural science’s study of more or less objective phenomena and the integration of soft system thinking from social and cultural context (Olwig, 2004). From the review of relevant literature we summarise that above all, the natural science community is mostly working on more and more detailed, narrow aspects and concepts, whereas the holistic view in landscape planning does not necessarily require that high level of detail at least due to scale reasons (Elliot, 2002). Furthermore, no clear structure has been established beyond the philosophical discussion on combining environmental planning approaches with those from economics and society (Bastian, 2004). Nevertheless, it is the linkage between natural science, socio-economic, and political categories which need to react of each other in a synergistic way – that will facilitate the most valuable way of planning (Neef, 1989). Since Neef established this important idea, researchers have tried to overcome the so-called ‘transformation problem’, without having succeeded so far. The main problems we are presently dealing with are:

- the understanding of the complexity of landscapes as such;
- the necessity of a strong background in natural-environmental, economic and socio-cultural disciplines;
- the decision making is usually complex or even hyper-complex with many stakeholders (Key et al., 1999; Brans, 2002);
- the general political influences on the landscape system by regulations, laws and established funding schemes;
- the gap between those analysing a landscape and those who decide (Luijten, 1999);
- the distinct perception of each disciplinary knowledge as such; and
- the different priorities in using and interests in socio-cultural and economic values.

Sociology, economy and ecology pursue different interest and strategies. However, these interests and strategies are interacting tends to indicate that several landscape functions are effective at the same time and in the same spatial unit. This again means that different material and amaterial processes take place simultaneously and interact in a synergistic, sometimes conflicting and non-neutral way. Correspondingly, all simultaneously interacting parameters are assumed as changing, as far as one parameter in this cause-effect chain is changing outside of its normal range of variation (e.g., ecological amplitude). Hence, it could be that we partly destroy, by high intensive tillage, the foundation of the intended land use per se. This means in detail that an economic act based on maximum yield – especially in farming – destroys the foundation of the ecological functioning and therewith the whole operating landscape system (e.g., due to soil erosion). Is the soil fertility due to soil erosion once lost, it is – as a result of the minimal regeneration rate – irretrievable. The evidence implies that functional segregation towards monoculture has apparently contributed to these problems of ecological functioning, is discussed economically and socially in Knauer (1993) and Meyer (1997).

It is clear, that it is the right time to establish, what kind of sustainable land uses can be used in parallel or one after another on given areas and which land uses could border each other without hampering healthy ecological cycles. Therefore, the planning of landscapes is receiving increasing attention in landscape science. Society’s awareness on future needs and demands require the paradigm of sustainable development which is connected to strategies to save time, money, and resources. The rational behind this planning method is that positive production of multiple use agricultural systems are maintained and that competing developments for producing most wanted goods and services supporting the major part of human society are resolved. Various human needs are to be met on the same limited terrain, forcing the entire landscape to be managed in a way that a variety of functions and demands from ecology, society, and economy can be met. This desire to plan, manage, and monitor landscapes is to enhance the functional integration through the ‘simultaneous presentation of different functional viewpoints’ (Brandt and Vejre, 2004).
FIGURE 12.1. Aspects of multifunctionality.

**12.3 Methodology**

**12.3.1 The multifunctionality of single plots and the whole landscape**

According to the definition of multifunctionality, a single piece of land can have multiple functions which are integrated, temporal or both (Figure 12.1). Therefore, one land unit can have multiple values at the same time. Additionally, this single piece of land can have alternating values at different times. This occurs for instance, when applying a crop rotation system whereby certain crop products follow one after another. These alterations can take place periodically, frequently, in shorter or longer periods. This is what we define as temporal dynamics and what we can measure by change detection on satellite imagery.

The highest aggregation of multifunctionality is achieved when combining the integrated multifunctionality and the temporal multifunctionality. The result is a temporal-integrated multifunctionality, having multiple functions (values) at the same time on one and the same land unit, which are alternating in time due to shifts in their priority or changing items.

However, the whole ensemble of multifunctionality may work well from one person's perspective, while others may perceive the same land unit in a different way, with less or different functions prioritised. While, a farmer's primary objective is production with the objective to maximise yield, the tourism industry is more concerned about landscape ecology and scenery or the water industry regards the preservation of good drinking water quality as the highest priority. All these necessities and demands from society need to be taken into account. Therewith we need a framework that represents the perspectives of the majority of the people. This majority comprises normally the stakeholders elected as well as groups of actors that have been identified as having leading decision roles. These groups mainly consist of the general community, politicians, economists, socio-cultural associations, the land owners, and scientists from several disciplines.

Besides the multifunctionality concerning one patch, the landscape per se comprises a spatial multifunctionality through its mixture of different bordering patch types. The more heterogeneous a landscape is, the greater the variations of patch types in space. This is usually measured with landscape metrics, such as diversity index or number of distinct patches (McGarigal, 2002). While in general, a high degree of diversity is seen as a good ecological status, there are some restrictions of bordering land use patch types due to ecosystem health reasons. For example intensive tillage areas as well as intensively used grassland areas directly bordering surface waters inherit a danger of nutrients runoff.

**12.3.2 Introduction to the overall approach**

As proposed above, multifunctional land use implies a mutual influence of the different kinds of land use, and therewith produces pressure on the environment. These
pressures arise from the competing needs of tourism and recreation industry, nature and environmental conservation, waste management, military use, provision of drinking water, food and fibre production, and many others. Considering and keeping track of all relevant pressures and further on aspects such as declared protection zones for water conservation, water reserves, flood retention, nature conservation, landscape conservation, classified natural sites, ski lifts, ski slopes, safety zones of airfields, hazard zones of shooting and explosive facilities, building prohibition, hazard and fire zones of railways, protection zones of national roads, protection zones for underground and overhead power lines, green belts, priority agricultural areas, military exercise zones, and so on it becomes obvious that careful planning is needed when allocating activities (functions) to a spatially explicit land unit.

Additionally, landscape planning and agricultural (landscape) management is influenced in several ways, such as agricultural trades steered by the Common Agricultural Policy (CAP), market policy and market performance, general economics, legislative conditions from the EC (Water Framework Directive, Natura 2000 directive, Landscape Convention) and national authorities, NGO’s, funding instruments, household issues, and ecological boundary conditions such as site and time specific natural conditions of different ecosystems resulting from terrain, hydrology, climate, air, and soil. All these influences have direct and indirect consequences on the land use structure, processes and the goods and services as outcomes. Hence, the qualities of the planning methodology must allow the landscape be studied from different perspectives, each emphasising certain processes and structures such as abiotic, biotic, and human-cultural components.

While landscapes are very complex in myriad social and biological ways, Klug (2002), Klug (2003) and Klug (in press) offers a new framework for understanding, analysing, interpreting, and monitoring landscapes as a series of tasks in a multicriteria analysis matched by logical inferences (Figure 12.2). The key idea of this framework is to adopt a land use strategy that focuses on a shift from functional segregation towards functional integration combining different theories and methodologies from social, political, economic and environmental perspectives. Ideally, methods such as the concept for the multifunctionality of landscapes, the strategic environmental planning, and others should be combined in such way that the strengths complement one another and the weaknesses are minimised. This

FIGURE 12.2. Schematic view on the hierarchical framework*.  

Priority of the ecological weights ranging from extensive to intensive land use

*Due to the complexity of the hierarchical framework it is not possible to present it fully in the space available here, therefore, the framework is only represented schematically. Further details can be found in Klug (2002).
method-mix should be locally adaptable and facilitates successful implementation of future landscape planning. Therefore, the developed methodology should be transferable to other regions with more or less equal boundary conditions. It should serve as a tool to be used to plan and steer landscapes towards a sustainable condition. The success of implementation is strongly related to the technological skills, social will and the ability of stakeholders and actors affecting the landscape to tailor landscape functions and processes to fit each other. Hence, the approach should provide a tool facilitating communication between science, local people and stakeholders who are responsible for decisions.

The main idea behind the concept is that planning and the realisation of an aspired future state imply a management of each patch within certain ecological, economic and social limits. These boundary conditions are framed by decision makers based on ecological criteria focusing the potential of each patch. Having developed these potentials, certain land use functions can be allocated to this area according to the matrix of functional superimpositions and temporarily modified. The modifications are to suit competing land resources and their claims from society. In general, this ensures the potential of each patch is not overburdened. Instead, this approach contributes to a better functioning in total and simultaneously minimises risks such as unclosed nutrient cycles. However, these efforts need strong social input and control with open-minded perspectives.

In general, the concept is based on a process-driven algorithm which investigates threshold values for certain attributes from a-prior derived geodatasets of functions and potentials according to De Groot et al. (2002) and with it dedicates a certain land use to a spatial unit (see Figure 12.2 page 85). These threshold values identify single properties and potentials of an area; for examples soil features as the soil texture and soil moisture or the usefulness of an area for ground water recharge expressed in five categories. Furthermore, datasets from ecology, economy and society can be integrated to reveal the primary functions to be best allocated to a certain area. These primary functions result from an assessment of a transdisciplinary compromise of interests from different stakeholders as developed in Klug (in press).

In detail the top-down structure of the hierarchical framework shown in Figure 12.2 is oriented from extensive to intensive land use to take care of environmental protection. Therefore, in each case the intensity allocated to an area is oriented to its load potential which is assigned by multiple properties questioned in the framework. This means, the more the hierarchical framework is processed, the higher the natural site potential and the possibility of putting loads to this area and the higher is the possibility to use this area intensively.

Having rejected a question at the left side the framework (e.g. number 7, Figure 12.2) proceeds from left to right (over number 8 to number 9 or 12, Figure 12.2). Here, further allocation of properties need to be assigned. The last stage, at the right side of the framework, a certain land use is allocated (e.g. grassland, or tillage). Each land use possibly being allocated frames the classification system. It is the same classification system we used to analyse the present landscape from ASTER satellite images. This allows a comparison of the present with the aspired future landscape state derived from the hierarchical framework to extract the problems to be solved.

In case of possible functional superimpositions as expressed in Chapter 12.3.1, the hierarchical framework joins the matrix of functional superimpositions (Figure 12.3) to assign land uses which are allowed to superimpose, are restricted to overlap, or not allowed to superimpose. Having allocated all land units within the landscape under consideration, the matrix of buffer functions determines necessary buffer strips to ensure that the competing land uses and ecological needs noted in Chapter 12 (Figure 12.4) have possible solutions developed.

12.3.3 The vertical and horizontal multifunctionality

The main function of the hierarchical framework is to maintain and further develop the process structure of the underlying ecosystem to get in return the best benefits demanded from society. Therefore, the hierarchical framework is the centre of the whole concept, being supported by the following modules surrounding it. In general, the model takes care of two perspectives:

a) vertical processes like functional superimpositions; and
b) horizontal harmonisation of different kinds of feasible spatial land use interconnections.

The matrix shown in Figure 12.3 explains the possibilities of area functions which are generally possible to superimpose, area functions that are precluding to overlap, and functions that are allowed to overlap with restrictions. These restrictions refer to manifold aspects which mainly can be classified by environmental protection restrictions.

This process structure therewith allows an easy allocation of different utilisation, regulation and protection function to one and the same land unit, whereby the functions are tailored to the concern of meso-scale landscape planning. They are suitable for mid-European conditions, but may be adapted to landscapes with special uses and functions.

Having applied the hierarchical framework and the matrix of functional superimposition, land use options that reduce site specific ecological risks and conflicts are revealed. However, this may not be true for neighbouring patches with horizontal process relations. The effects of off-site intrusion need to be minimised subsequently by buffer strips.

Buffers are best described as areas of land in permanent vegetation that help control pollutants and manage other environmental concerns such as nutrient discharge. Filter strips, riparian buffers, corridors, field borders, grassed

<table>
<thead>
<tr>
<th>Functions</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large water protection areas</td>
<td>-</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Middle ecological compensation zone</td>
<td>-</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Inclusion protection zones</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Buffer area between protection and landscape zones</td>
<td>-</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Retention areas</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Amnesiacs of natural landscape elements</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Paddocks</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Areas of rivers in narrow sense</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Soil protection areas</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Bogs, fens, and mires</td>
<td>-</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Bird and fauna protection areas</td>
<td>-</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Exclusive protection areas</td>
<td>-</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Forest / plantation</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Extensively used orchards</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Intensively used orchards</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Extensively used pasture</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Intensively used pasture</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Extensively used grassland</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Intensively used permanently grassland</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Shade with management restrictions</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Shade without management restrictions</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Recreation area</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Areas with roads, infrastructures</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Lakes</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Reservoirs</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Places, bogs, and mires</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Areas without vegetation</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Ice, firm, and snow areas</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

List of restrictions respective condition numbers [n]:

1. As far as not to high slurry and/or pesticides and herbicides.
2. Dependent on the species and immission type.
3. Larger / closer wood distances may represent insuperable hindrances for cold air streams (fresh air production) towards the over-heated or polluted city.
4. As far as it is a thicket, utilisation is in dependence on soil sealing possible; in case of forest only location equitableness stands possible.
5. The surrounding retention area can be used as intensive meadow (yield only as straw, not as fodder usable).
6. As far as the existent or aspired vegetation is resistant against pollutants or nutrient input.
7. As far as forest / plantation is not too high.
8. As far as habitats and species are not impaired in their way of life.
9. Possibly protection measures for cultural witnesses necessary (e.g. heathland).
10. Limitations result from mechanical cultivation.
11. Small parcelled tillage possible.
12. As far as the vegetation is sufficient for pasture cattle.
13. As far as trees are not impaired by the retention function.
14. As far as locations are not too wet (soil sealing and sludging).
15. As far as used as retention area and dynamic is wanted.
16. As far as odour from slurry is not too high.
17. As far as habitats and species are not impaired in their way of life.
18. Superimposition from summer to winter by use of sliding or sledding possible.
19. As far as no wind erosion is occurring on the vegetationless locations.
20. Can superimpose when firm, snow or ice is temporary melting.
21. A certain degree of bushes can be tolerated.
22. Bogs, fens, and mires can be opened up for people on guided tours.
**FIGURE 12.4. Matrix to determine the necessity for buffer strips modified after Klug (2000), Mosimann et al. (2001), Klug (2002).**

<table>
<thead>
<tr>
<th>Land Use and Protection Zones</th>
<th>1</th>
<th>2</th>
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</thead>
<tbody>
<tr>
<td><code>Witnesses of cultural landscape elements</code></td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Geotypes</td>
<td>-</td>
<td>O18</td>
</tr>
<tr>
<td>Areas of rivers in narrow sense</td>
<td>-</td>
<td>O16</td>
</tr>
<tr>
<td>Soil protection zones</td>
<td>-</td>
<td>O16</td>
</tr>
<tr>
<td>Bogs, fens, and mires</td>
<td>-</td>
<td>O16</td>
</tr>
<tr>
<td>Fens and fauna protection zones</td>
<td>-</td>
<td>O13</td>
</tr>
<tr>
<td>Exclusive protection areas</td>
<td>-</td>
<td>O16</td>
</tr>
</tbody>
</table>

**Matrix to determine the necessity for buffer strips**

<table>
<thead>
<tr>
<th>Unlikely</th>
<th>Very unlikely</th>
<th>Possible</th>
<th>Likely</th>
<th>Very likely</th>
<th>Certain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forest / plantation</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Extensively used orchards</td>
<td>-</td>
<td>-</td>
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<tr>
<td>Intensively used orchards</td>
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<tr>
<td>Extensively used pasture</td>
<td>-</td>
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<tr>
<td>Intensively used pasture</td>
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<tr>
<td>Extensively used grassland</td>
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<tr>
<td>Intensively used permanent grassland</td>
<td>-</td>
<td>-</td>
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<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Tillage with management restrictions</td>
<td>-</td>
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<td>-</td>
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<td>-</td>
</tr>
<tr>
<td>Tillage without management restrictions</td>
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<tr>
<td>Recreation area</td>
<td>-</td>
<td>-</td>
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<td>Settlement, roads, infrastructure</td>
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<td>-</td>
</tr>
<tr>
<td>Lakes</td>
<td>-</td>
<td>O17</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rivers</td>
<td>-</td>
<td>O17</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Foliage and shrub vegetation</td>
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<td>-</td>
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<td></td>
</tr>
<tr>
<td>Areas without vegetation</td>
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</tbody>
</table>

**Buffer space under certain conditions required [n]:**

1. Necessary when the danger of expansion of location-foreign species in neighbouring ecotopes is possible.
2. Necessary while high emissions at the settlement edge through traffic or industry.
3. Necessary when traffic is >10,000 vehicles per day.
4. Necessary in open recreational facilities as picnic sites or playgrounds.
5. Necessary by forests in drain area below tillage areas.
6. Necessary by forests in drain area below meadows or pastures.
7. Structured forest edges are sufficient.
8. As far as protected species are endangered.
9. In case of meadows in drain area below tillage areas.
11. Dependent on the structure of the stock and the utilisation form.
12. In case of emergency of substance lost (herbicides, fungicides, nutrients, sediments).
13. In case of risk of bush encroachment.
15. As far as no impairment of the soil is expected.
16. As far as no impairment of the surface water through forest use is expected.
17. Necessary while sediment loss.
18. In case of endangered or disturbed ecosystem.
19. In wind direction lying settlements hedgegrows as dust catcher necessary.

**Key:**

1. Utilisation function
2. Protection function
3. Buffer space always required
4. Buffer space partly required
5. Buffer space not required
waterways, field windbreaks, shelterbelts, and contour grass strips are all examples of buffer (McGarigal, 2002; USDA, 2005). Forman and Godron (1986) define buffers as ‘narrow strips of land which differ from the matrix on either side’ that ‘may be isolated strips, but are usually attached to a patch of somewhat similar vegetation.’

The main reasons for buffer strips allocated to different kinds of adjacent patches relate to:
- improvement of soil, air, and water quality (removal of nutrients, pesticides, pathogens and sediments, reduce flooding);
- enhancement of wildlife habitat (biotopes, corridors, connecting elements);
- restoration of biodiversity;
- creation of scenic landscapes; and
- economic benefits (incentive payments, higher yields, protect buildings, roads, and livestock).

According to these theories, a matrix to determine the necessity to implement buffer strips has been designed with the same structure as the matrix of functional superimpositions; except the regulation functions (Figure 12.4). The regulation functions are dedicated to non-specific land use types and represented by the utilisation functions.

In case a buffer strip needs to be assigned between the borders of two patches, the buffer width is an issue often discussed. From a policy perspective in spatial development plans, national or regional laws, directives norms, or funding schemes buffers are often specified with a width between 5–10 m without considering any spatial ecological background information. In reality, the width strongly depends on the spatial surrounding of the two patches bordering each other, the type of each patch as well as the underlying problem to solve. As an example a grassland area bordering surface water may only need a narrower buffer strip than an intensively used tillage area. But both buffer strips need to be enhanced in case the slope towards the surface water increases. Therefore, a rule base needs to be formulated on the basis of morphological parameters derived from a digital elevation model (e.g. slope, exposition, slope length, curvature) or other geodatasets as for instance, information on wind direction and intensity in case of wind erosion problems. This rule base defines threshold values for buffer width which can be allocated semi-operationally using GIS techniques.

12.4 Discussion and conclusion

Due to the increasing challenge to develop more sophisticated types of land use regulations (e.g. the CAP-Reform) it becomes evident that former planning traditions as well as farmer’s tasks on their land need to be gradually replaced. The realisation of this change in agricultural practices is strongly dependent on the insight of farmers and their understanding and recognition of land use in respect to differences in landscape conditions and an awareness of the contribution, good land management makes to society in general. Farmers have a multifunctional role to play as providers of both market goods and public services. Today, especially the non-market products are seen as by-products of market commodities and have not been valued in terms of money transfer. But these public goods (positive externalities) give the landscape values that we classify as open landscapes, biodiversity, leisure areas, etc.

We assume and recommend that transdisciplinary landscape planning will – with a high probability – become more widespread as many important trends concerning the interest for landscape planning at landscape scale have emerged in recent years. Being aware that this trend might support a more transparent and accepted landscape planning method, it should also be acknowledged that such approaches require high resource input from an organisational point of view.

However, we argue that transdisciplinary planning of different aspects of landscape functionality might add to the understanding of ongoing landscape changes (positive and negative trends) and widen the range of options for the formulation of policy measures as well as the activity radius of farmers which would lead to a more sustainable use of our landscapes. From those findings we can formulate guidelines for improving our present landscape towards an aspired situation in future. To give recommendations to reach the aspired future state, the following three points need to be fulfilled:
- people meet, respect each other, and are willing to collaborate;
- the agreement on a strategic conceptualisation and solution to find a commonly agreed aspired future state; and
- formulation of an action plan to reach the objectives agreed on before.

With a deeper insight in the cause effect relationships and the interconnectedness of processes we should be able to evaluate intervention options and – to a certain extent – make a prognosis about the expected changes. Therefore, the major advantage of a holistic planning method is to understand and improve our methods applied for a non-chaotic steering of our future landscape. The landscape’s future will only be secured in its multifunctionality if we are more sensitive with nature and our interaction with it. This requires, not only doing everything to increase the efficiency of resource use for maximum yield; moreover it places us on the path to a sustainable lifestyle of human.

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