5

Integrating physical and human dynamics in landscape trajectories: exemplified at the Aulnages watershed (Québec, Canada)

Julie Ruiz[#] *and Gérald Domon*[#]

Abstract

With the increasing complexity of landscape issues and a paradigm shift towards holistic approaches, there is a crucial need to understand both the human and physical dynamics of landscapes and their interactions. From a holistic perspective, the landscape can be viewed as the combined result of dynamic interactions between land and individual. Based on this view of the landscape, this paper develops an approach based on the concept of landscape trajectory. Landscape trajectory is proposed as an intrinsic landscape characteristic, describing the nature of the interactions between physical and human dynamics. It recognizes three types of landscape trajectories: (i)

[#] Chair in Landscape and Environmental Design & School of Landscape Architecture, Faculty of Environmental Design, Université de Montréal, C.P.6128, Succursale Centre-ville, Montréal, Québec, Canada, H3C 3J7. E-mail: julie.ruiz@umontreal.ca

the landscape trajectory that is characterized by complementary interactions between physical and human dynamics, (ii) the landscape trajectory that is characterized by a directional change in physical and/or human dynamics, which leads to conflicting interactions, and (iii) the landscape trajectory that is characterized by a separation in physical and/or human dynamics, which also leads to conflicting interactions. These trajectories are illustrated by the case of areas of intensive agricultural use and a preliminary application in the Aulnages watershed (Québec, Canada). Indeed, areas of intensive agricultural use constitute one example of a directional change of human dynamics toward industrialized agriculture that has led to new land structures, adapted to the demands of new agricultural practices. Because of changing values, uses, behaviours and perceptions, these areas are now subject to a separation within the human dynamics. This new context requires ways to modify landscape trajectories in order to be able to respond to the different uses and needs of inhabitants. To address this question, a better understanding of past and current landscape trajectories is required. However, such a holistic approach raises important issues at the operational level. Six are discussed in this paper: the use of a multi- or interdisciplinary approach, the choice of appropriate methods to study each dimension, the establishment of a dialogue between the different methods selected, the order of the dimensions studied, the choice of appropriate spatial scales and, finally, the combination of multiple temporal scales.
Keywords: landscape trajectory; integrative approach; rural landscape; areas of intensive agricultural use

Introduction

Presented with the complex issues of contemporary landscapes and the importance of multifunctional landscapes for sustainable development, there is an increasing awareness by researchers of the importance of studying both the physical and the human processes that shape landscapes. These processes are generally studied using two types of approaches that are derived from the social or the natural sciences. Several authors have pointed out the necessity to transcend the disciplines and to develop integrative approaches (Zonneveld 1995; Hobbs 1997; Moss 2000; Naveh 2000; Wu and Hobbs 2002; Palang and Fry 2003). Inter- and trans-disciplinary studies have been identified as a necessity for conducting research on complex landscape issues (Tress and Tress 2001), and the concept of holism as having the possibility of increasing collaboration between different approaches (Palang and Fry 2003; Naveh 2004). In this perspective, human and physical dimensions of landscapes need to be treated with the same degree of consideration and in a dynamic way (Tress and Tress 2001; Palang and Fry 2003; Vejre, Aaby and Olwig 2004; Bastian 2004; Naveh 2004). Reciprocal relationships or interactions between three basic dimensions, human, physical and temporal, need to be the focus of the analysis, rather than simply reporting their co-existence (Haines-Young and Potschin 2004). However, such holistic approaches present the problem of being made operational (Palang and Fry 2003; Bastian 2004).

The objective of this paper is (i) to develop a conceptual approach based on the concept of landscape trajectory which attempts to investigate the interactions between human, physical and temporal dimensions of the landscape, and (ii) to discuss the application issues of this approach at the operational level. First, the concept of landscape trajectory is developed. Second, it is illustrated with the example of the landscape concerns arising in areas of intensive agricultural use, and with a preliminary application in an agricultural watershed. Third, the methodological issues

facing the application of such an approach are discussed, in order to point out some of the challenges facing integrative research.

Landscape trajectory: a conceptual approach for the integration of human and physical dynamics of landscapes

Landscape and landscape change from a holistic perspective

In the face of the increasing complexity of landscape issues and a paradigm shift towards holistic and organismic approaches (Naveh 2000), landscape "is understood more and more as a complex, highly-integrated system" (Bastian 2004, p. 76). From such holistic perspectives, all landscape dimensions are relevant and need to be treated with the same consideration, as are the interactions between them (Tress and Tress 2001). Moreover, a particular emphasis is placed on the importance of treating human aspects and dimensions "as an intrinsic part of landscape processes and functions" (Naveh 2004, p. 37) and to consider the mental dimension equally to the physical dimension (Bastian 2004).

Indeed, rapid changes in society and the environment during the last five decades have drastically modified past landscapes to create new ones. These new landscapes "have been superimposed rather than being integrated" (Antrop 2005, p. 25). Their dynamics, with increasing speed and scale, constitute the first main difference with landscapes of the past. The second difference is related to the changing values, uses, behaviours and perceptions (Brandt and Vejre 2004b). From a holistic perspective, two main factors of landscape change are recognized: the natural processes and the human activities (Antrop 1998; Luginbühl 2003). Naveh (2004) has pointed out the relevance of the new development in non-linear thermodynamics of irreversible processes for a more comprehensive view of landscape dynamics, and has insisted on the fundamental role of humans. Thus, if one of the fundamental aspects of landscape is to evolve continuously in time, and if landscape changes are the result of interrelated physical and human transformations, there is a crucial need for a more comprehensive view of these interactions.

The model of individual – land interactions

Based on the holistic definition of landscape inspired by Tress and Tress (2001), a generic landscape model of individual – land interactions has been developed. It focuses on the interactions between the human and the physical dimensions of landscapes. In this model, three entities constitute the landscape: the land, the individual and the interactions between them (Figure 1).

The landscape is the combined result of dynamic interactions between the object (physical reality, called land) and the subject (individual). The land constitutes the material support of perceptions, that is to say, what people can perceive. Individuals perceive land and give value to it using attributes, features or properties (Poullaouec-Gonidec et al. 2001). From this perception derives an image of the land that varies according to culture, experience, sensitivity, personal filters etc., of the individual, and evolves with time. Through time, land will be seen differently according to the evolution of values. This perception influences land uses that are also adapted to land features (Domon, Beaudet and Joly 2000). According to Madsen and Adriansen (2004), uses are defined as actions related to the land carried out by individuals, and values are defined as traditions, thoughts, beliefs, preferences and motives. This makes the relationship between object and subject the core of landscape analysis. Thus, land, uses

and values of individuals constitute the three aspects we need to study in a coherent whole for a better understanding of their interactions.

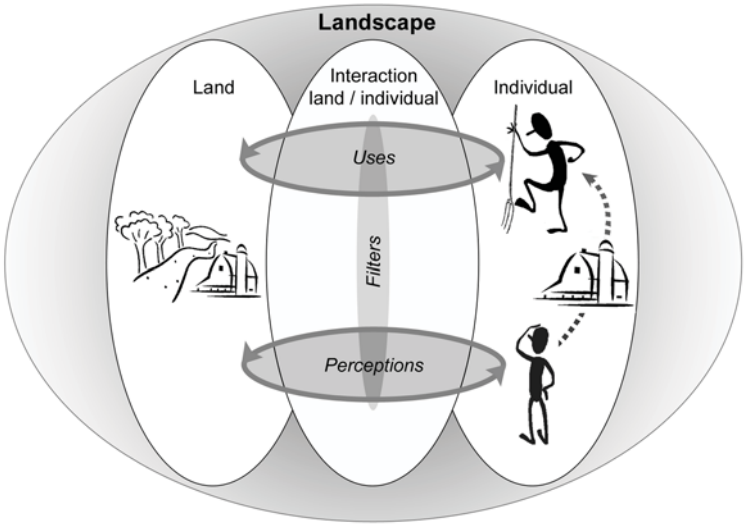

Figure 1. Generic landscape model (adapted and modified from Tress and Tress 2001)

Landscape trajectory

The interactions also need to be defined and conceptualized through time. The concept of landscape trajectory is proposed as an intrinsic landscape characteristic, describing the nature of the interactions between physical and human dynamics. Landscape trajectories are embedded in a political, socio-economic and technological context. According to the generic landscape model of individual – land interactions, two main dynamics shape landscape trajectories, a human one and a physical one. As Antrop (1998, p. 156) pointed out, "landscapes are composed of many different components which have their own dynamics. [...] many changes will occur simultaneously and continuously, all at their own speed and magnitude". Four fundamental aspects of landscape change have to be considered: the nature of change, the frequency of change, the magnitude of change and the reference time-base used to study it (Antrop 1998). These aspects are necessary for the comprehension of each dynamic, and also for the landscape trajectory. The human dynamics are associated with uses and values of society, groups of individuals and individuals. Physical dynamics refer to ecological and physical processes and to transformations in the material land structure. Furthermore, the two dynamics influence each other. Their interactions could be characterized as complementary or conflictual. Three types of landscape trajectories can be distinguished:

1. the landscape trajectory that is characterized by complementary interactions between physical and human dynamics;
2. the landscape trajectory that is characterized by a directional change in physical and/or human dynamics that leads to conflictual interactions;
3. the landscape trajectory that is characterized by a separation in physical and/or human dynamics that leads also to conflictual interactions.

1. Landscape trajectory characterized by complementary interactions between physical and human dynamics

In this first type, individual actions modify the land, while individuals gradually adapt to these modifications, and so on (Figure 2). The evolution of some

Mediterranean landscapes of the past has the characteristics of a dynamic balance between people and nature, and provides an example of this type of landscape trajectory (Naveh 2004). These complementary interactions create a dynamic stability or 'meta-stability' which maintains the landscape trajectory. The challenge here is to maintain the physical and human dynamics inside some satisfactory limits.

Figure 2. The landscape trajectory characterized by complementary interactions

2. Landscape trajectory characterized by a directional change in physical and/or human dynamics that leads to conflictual interactions

In this second type, one of the dynamics changes 'direction' while the other continues its initial evolution (Figure 3). Directional change refers to a significant modification in the nature, frequency and/or magnitude of the dynamics. It could be caused by changes in human activities or by a natural process, such as a natural disaster. Thus, a modification of the human dynamics will lead to a discrepancy between human uses and values, and the physical dynamics (Figure 3a). Similarly, a change of the physical dynamics will lead to a modification of ecological processes or physical attributes, which will then become unable to respond to the human dynamics (Figure 3b). This type of landscape trajectory could lead to a complete separation between the two dynamics. The 'space' between human and physical dynamics reflects the importance of the tensions between individuals and the land. This space can then become a source of conflictual interactions. In such a case, human activities are often able to modify physical dynamics in order to generate a new landscape trajectory adapted to their needs. The creation of areas of intensive agricultural use after World War II represents one example of this second type of landscape trajectory (see second part of this paper).

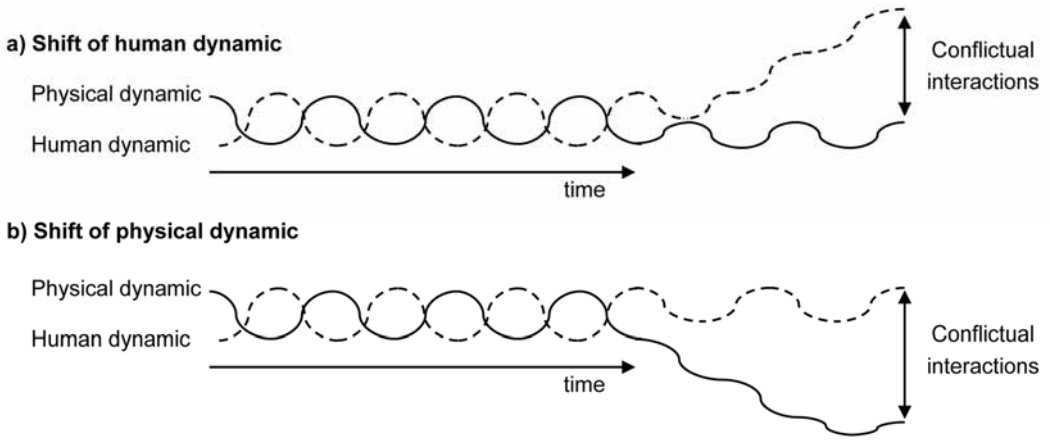

Figure 3. The landscape trajectory characterized by conflictual interactions

3. Landscape trajectory characterized by a separation in physical and/or human dynamics that leads to conflictual interactions

In this last type, a modification creates a separation within one of the dynamics (Figure 4). In the case of a separation within the human dynamics, the values and uses continue to co-evolve with the physical dynamics for a part of the population, while for another part of this population, land and natural processes are becoming out of phase (Figure 4a). This could be the case of current rural landscapes faced with the increasing arrival of urbanites, and the associated changes in values and uses. The same separation could occur within the physical dynamics (Figure 4b). For example, the fragmentation of a forest could lead to the creation of two islands; the first one able to sustain its natural processes and the second, with a smaller area, unable to react to human activities. In that landscape-trajectory type, the interactions become progressively conflictual, and the future is more uncertain.

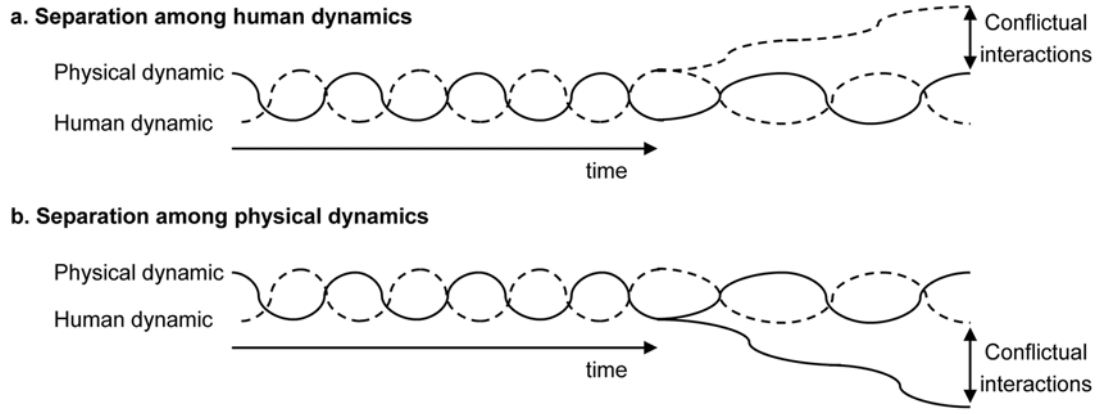

Figure 4. The landscape trajectory characterized by partially conflictual interactions

As Naveh (2001) points out, the challenge for landscape research is to become an anticipatory science fit for shaping the evolution of landscapes. Understanding landscape trajectories could be seen as a way to anticipate this evolution with the goal of fulfilling the various demands and expectations of uses and values "at the same time in the same landscape without creating social conflicts and/or environmental degradation" (Vejre, Aaby and Olwig 2004, p. 159).

Landscape trajectories in areas of intensive agricultural use: a preliminary application

Landscape issues in areas of intensive agricultural use

To illustrate the usefulness of the approach based on the concept of landscape trajectory, the case of areas of intensive agricultural use is given. The advent of productivity-oriented agriculture in industrialized countries since World War II has drastically accelerated and modified landscape dynamics. Intensification, concentration and specialization are the main processes leading to the homogenization of the landscape and almost mono-functional agricultural land use in areas suitable for agriculture (Figure 5) (Bowler and Ilbery 1999).

Figure 5. Intensive agricultural areas in the southern part of Québec (Canada). Photo: J. Ruiz

Similar landscape transformations were emphasized in different countries (Meeus, Wijermans and Vroom 1990; Domon, Bouchard and Gariépy 1993; Poudevigne and Alard 1997; Hietala-Koivu 1999). The fragmentation of wooded areas, the disappearance of pasture and wetland associated with the increase in cultivated areas, the removal of isolated trees, hedges and barns constitute some of the most common processes. Moreover, soil draining has contributed to the standardization of biophysical features, creating large areas of uniform and rectilinear plains. These transformations are one example of a directional change of human dynamics towards industrialized agriculture that has led to new land structures adapted to the demands of new agricultural practices.

Land-use changes in these areas of intensive agricultural use have also actively contributed to environmental problems (erosion, water and soil pollution, salinization, etc.), to the loss of biodiversity, to the removal of cultural and amenity values of the landscapes. These transformations are currently generating new conflicts in communities on how to use and manage the landscape.

Indeed, associated with the growing proportion of urbanites, some rural areas are undergoing a socio-demographical change with a reduction of farmers, while tertiary-sector workers and retirees are increasing. Even if this process is not uniform within rural areas (Paquette and Domon 1999), in some areas of intensive agricultural use these demographical transformations introduce new uses and expectations (residential, recreation, conservation etc.), besides the more traditional use of agricultural production (Vos and Meekes 1999). All of these phenomena cause radical changes in the way people see the landscape. Emerging conflicts reflect the growing discrepancy between the specific requirements of an agricultural activity, often perceived as impoverishing the landscape characteristics, and an increasingly diversified community requiring some new and better suited functions for rural landscapes. We can no longer consider rural areas as being solely agricultural. They have become multifunctional, and must support multiple uses and provide new productive, environmental and social functions (Brandt and Vejre 2004a). They are now subject to many new viewpoints and values of a more diversified population. These socio-demographical changes are one example of a separation within the human dynamics that generates conflictual interactions between physical and human dynamics, but also within human dynamics.

The Aulnages watershed: finding ways to create new complementary interactions between human and physical dynamics

In Québec (Canada), as elsewhere, areas of intensive agricultural use are affected by new demands coming from socio-demographical transformations of the rural zone. Covering 30 km^2, the Aulnages watershed is located in the south of Québec (Figure 6). It is a representative part of areas characterized by an intensification of agriculture as defined by Domon (1994). In this part of Québec, soil conditions, climate and proximity to an international market (USA) have favoured a concentration of farms during the last decades.

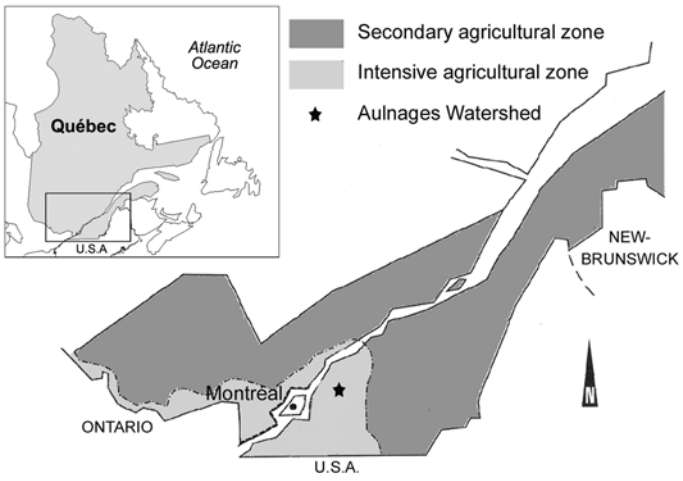

Figure 6. Location of the Aulnages Watershed (Adapted from Domon 1994)

An analysis of census statistics reveals that the farming population and the number of farms have been reduced by more than two thirds of their total numbers since the 1970s, even though the total rural population is increasing. As for the cultivated zones, although their area has remained stable, their nature has changed. While oats, hay and pasture were the main land cover during the 1970s, maize and soy now cover more than 86 % of cultivated lands, and the majority of farms also have swine production. This specialization of farms has led to the neglect of old barns and the construction of new ones more adapted to swine production (Figure 7).

Figure 7. The Aulnages Watershed: isolated trees and abandoned barn facing the development of pig-production and maize. Photo: J. Ruiz

Preliminary results from an aerial-photograph interpretation point out the main trends in the evolution of the land (Figure 8). Results confirm the census data and show that cultivated areas have remained quite stable since 1950. Two modifications associated to the mechanization of agriculture can be clearly identified: a drastic disappearance of isolated trees and the straightening of the water courses to remove meanders accelerate draining. In spite of this trend towards landscape uniformity, numerous natural hedges have appeared during the last five decades. These hedges are an indication of the neglect of non-productive areas of farms, such as draining ditches (Schmucki et al. 2002).

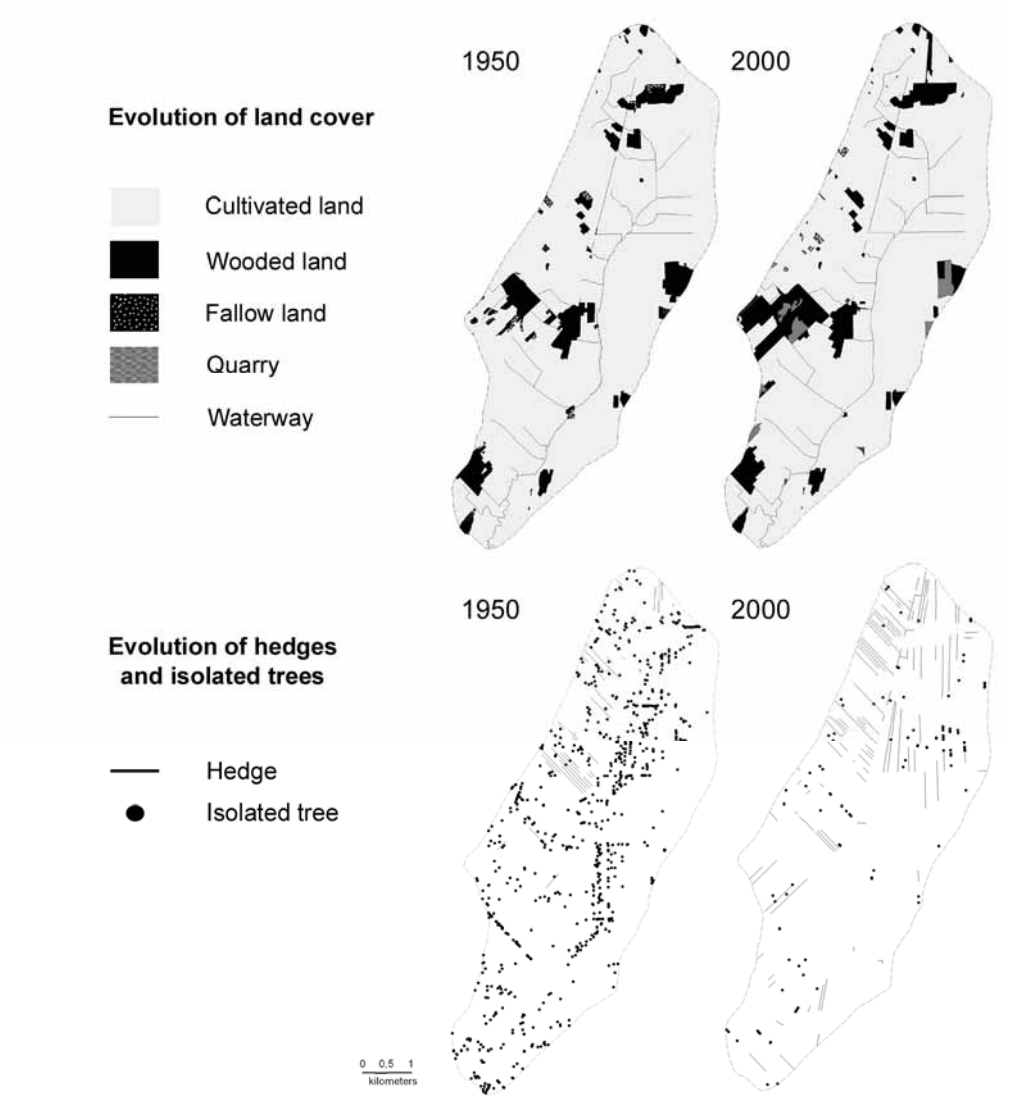

Figure 8. Land dynamic 1950-2000 in the Aulnages watershed

Faced with problems of soil erosion and pollution of surface waters, farmers of the watershed have gathered in a management committee, begun in 2000, in order to promote agro-environmental measures. The creation of this committee is an indication of the willingness of farmers to reduce the impacts of their agricultural practices on the environment, and could also indicate their willingness to allow different users and land uses to co-inhabit in a complementary way.

Although landscapes question in areas of intensive agricultural use have been up to now strongly related to environmental restoration (pollution and soil-degradation control), the diversification of the demands on rural land and the negative perception of these areas by non-farmers, call for the consideration of the other dimensions of the landscape, such as cultural, aesthetic and amenity values (Brandt and Vejre 2004a). How can the landscape trajectory be modified to be able to respond to the different uses and needs of the population? In the case of the Aulnages watershed, understanding the landscape trajectory raises three questions. The first is related to the physical dynamics: what can we learn from past land dynamics? What are they today? As mentioned before, the preliminary analysis of aerial photographs provides some interesting results. The second question is related to the human dimension of landscapes: which uses and values shape the landscape, and how is industrialized agriculture valued? Finally, the third question is related to the interactions between both dynamics: how can we combine the productive functions and the new socio-demographical reality in this area of intensive agricultural use?

As pointed out by Haines-Young and Potschin (2004), the challenge is to identify new land structures that are adequate for the social, economic and environmental needs, but also to generate new qualities and positive perceptions of these areas. A better understanding of landscape trajectories could be seen as a first step towards the development of a knowledge base in support of the harmonious co-evolution of physical-spatial and human dynamics, based on the complementarity of their interactions.

Methodological issues for the study of landscape trajectories

The challenge is to make this approach, which is based on the landscape trajectory concept, operational. As discussed in the first part of this paper, we need to be able to analyse land, uses, values and their interactions through time in a coherent whole. Indeed, such an approach calls for methods derived from humanities and natural sciences, but also for links between them, and through those address the questions related to integrative approaches. We propose six methodological issues that are particularly crucial to address:

1. The use of a multi- or interdisciplinary approach
2. The choice of appropriate methods to study each dimension
3. The establishment of a dialogue between the different methods selected
4. The order of the dimensions studied
5. The choice of appropriate spatial scales
6. The combination of multiple temporal scales

1. The use of a multi- or interdisciplinary approach

First, we have to ask if the integration of the different dimensions through an interdisciplinary approach is really necessary, or whether the simple observation of the phenomena under different perspectives (multidisciplinary) could not be sufficient. As Tress et al. (2005, p. 187) note “for many landscape problems insights gained by viewing the problem from the different perspectives provided by parallel studies may be the best and most reliable way forward”. The complexity and diversity of questions raised for the sustainable planning of landscapes make these particularly relevant. In some cases, a multidisciplinary study establishing relationships between various landscape dimensions according to different disciplinary perspectives, or a simple overlay of the results stemming from different methods, seem to provide sufficient

understanding of the physical and human dynamics of landscapes to guide future development. As an example, while limiting itself to simple linkages emerging from the observation of the study area from different perspectives (biophysical potentials and constraints of the area under study; perception and motivations of land owners; programmes and policies), the research of Domon et al. (1993) has allowed the identification of the dimensions which need to be included in implementing a sustainable planning strategy for agro-forested landscapes. In other situations and contexts, it is likely that an adequate understanding of landscapes can only be attained using an inter- or transdisciplinary approach. Thus, the definition of the problem appears as a critical step of any research project, in order to identify the approach most suited to the landscape problem (Bastian 2004). We believe that it is the nature and complexity of the observed phenomena that must constitute the basis for the selection and, if necessary, for the definition of the conceptual and methodological framework, which can be multidisciplinary or integrative.

2. The choice of appropriate methods to study each dimension

Once the approach is defined, what methods should we use to study each dimension and their interactions? The study of human dimensions calls more often for methods stemming from the social sciences, while the study of physical dimensions is often done through methods arising from the natural sciences. In these multi-method studies (Palang and Fry 2003; Sooväli et al. 2003) the challenge is to associate quantitative data to qualitative data. In such a case, methods likely to answer research questions, and to generate knowledge that is possible to combine with other sources of information have to be selected. As Madsen and Adriansen (2004) suggest, it is difficult, even impossible, to combine all of the approaches, and some are in some ways too distant from each other, on either an epistemological, conceptual or methodological point of view. The challenge then becomes how to select methods for which joint use does not distort their integrity. Sooväli et al. (2003) have chosen to combine the study of social representations with the changes in physical landscape. For the case of landscape trajectory, one possible way could also be to study, on the one hand, land dynamics using traditional methods of landscape ecology, and on the other hand, uses and values taking into account aspects of rural sociology and agricultural geography (Paquette and Domon 2003; Madsen and Adriansen 2004). The purpose being to retain a closed link between the uses and values that are particular to an individual, or to a group of individuals (Madsen and Adriansen 2004).

3. The establishment of a dialogue between the different methods selected

However, once these methods are selected, how could a dialog be facilitated between each of them in order to provide an integration right from the beginning of the study? When should the different methods be linked (sampling, data collecting, data treatment, etc.)? One could also legitimately ask whether the study of interactions is really possible using ‘traditional’ methods, meaning methods developed within specific disciplines? As suggested by various authors (Palang, Mander and Naveh 2000; Wu and Hobbs 2002), because integration is in itself a new perspective, should we not rely on innovative methods? If this is the case, what would those methods be like? How can we succeed in defining them? One possible way could be to assist in the integration of disciplinary knowledge with original tools, such as scenarios, which can constitute the basis of a multidisciplinary dialogue, simultaneously integrating the local community (Tress and Tress 2003). A more in-depth study of land-cover dynamics is also a useful tool, as it

constitutes the expression of land-individual interactions during the most recent time period (Brandt and Vejre 2004b).

4. The order of the dimensions studied

One could also ask if the order in which different dimensions are studied is likely to influence the results of the research. If so, with what dimension should we start the analysis? Naveh (2001) suggests that it is necessary to place the landscape studied within a historical perspective, and to reveal the past in order to understand the present. An in-depth understanding of the study area appears to be a prerequisite to an integrative study. Thus, the challenge is to find historical data that have the same spatial scale (Vejre, Aaby and Olwig 2004).

5. The choice of appropriate spatial scales

The question of the spatial scale which is best for understanding landscape processes is also present: does a common spatial scale exist for the study of physical and human dynamics? What is the appropriate scale to examine physical attributes, as well as the values and uses of individuals, in order to provide a good understanding of these dimensions, and to put the results into appropriate context? In landscape ecology, spatial units of analysis are generally based on ecological or biophysical reality, but do not necessarily reflect a management or planning reality. Moreover, values are also scale-dependent, and the physical attribute values at a local scale are not the same as those at a regional scale. However, as Baudry et al. (2000) have shown, a multi-scale approach in which one of the analysis units also constitutes a management scale for the land, can be used effectively to establish links between different methods. For example, for the case of the Aulnages watershed, the analysis can be done at two spatial scales, first, on the whole watershed to acquire a general comprehension, then, on the cadastral lots, which provides a spatial unit that is linked to the daily uses of the land.

6. The combination of multiple temporal scales

The examination of several studies leads us to a last question: how is it possible to take into account different time scales within an integrative framework? Sustainable landscape planning calls for a historical understanding of the different dimensions and their interactions (Nüsser 2001). If it is generally possible to document land-use changes with maps or aerial photography, the human dimensions and the evolution of the social values of landscapes are much more difficult to document, particularly in North America. These dimensions call for the use of unusual and fragmentary data (novels, art works, etc.), which are usually only available for landscapes with well-recognized natural or cultural values. In addition, beyond the simple issue of available information, which limits the analysis, the question of the temporal scale selected is essential. Indeed, physical dynamics (e.g. vegetation succession) are often expressed according to temporal scales that are much longer than the human dynamics, which themselves largely exceed the temporal scale of government programmes and policies. In such conditions, what temporal scale should we use to understand landscape dynamics? How do we document the evolution of the different components of landscapes? And above all, how do we integrate dynamics that have different temporal scales?

Conclusions

Confronting land dynamics to uses and values will help us to specify the order and the nature of the gap between physical and human dynamics. In the case of the Aulnages watershed, the objective is to propose a preliminary strategy that allows the different uses and users to fit together in a complementary way in areas of intensive agricultural use. Indeed, shaping future rural landscapes requires an in-depth understanding of landscape trajectories, and the integration of human and physical dynamics. This integration, and the understanding of the interactions, is an important challenge for landscape research. Although it may be impossible to explain each of these relationships, we have to be able to define and explain the relationship which is the most relevant within a particular context. Even though integrative conceptual frameworks have been developed, how to make the methods of these frameworks operational in a coherent way raises other questions. The paths towards integration are multiple and the solutions diverse. The use of multi-method studies constitutes one of them. They present multiple benefits for integration and their potentials, such as the possibility of using inductive and deductive approaches in a sequential way, deserve further investigation. The study of reciprocal links between two dimensions often requires the creation of new knowledge, skills and methods, which are imminently well suited for promoting dialog between disciplines. On the other hand, if the objective is to solve rural problems, the new knowledge, skills and methods must also be affordable to decision makers and the population.

Acknowledgements

We thank Marc Antrop, Richard Hobbs, Bärbel Tress and Gunther Tress for helpful discussions and comments to improve the manuscript. This paper was supported by research grants to Gérald Domon from the Social Sciences and Humanities Research Council of Canada.

References

Antrop, M., 1998. Landscape change: plan or chaos? *Landscape and Urban Planning*, 41 (3/4), 155-161.

Antrop, M., 2005. Why landscapes of the past are important for the future. *Landscape and Urban Planning*, 70 (1/2), 21-34.

Bastian, O., 2004. Functions, Leitbilder, and Red Lists: expression of an integrative landscape concept. *In:* Brandt, J. and Vejre, H. eds. *Multifunctional landscapes. Vol. 1. Theory, values and history*. WIT, Southampton, 15-94. Advances in ecological sciences vol. 14.

Baudry, J., Burel, F., Thenail, C., et al., 2000. A holistic landscape ecological study of the interactions between farming activities and ecological patterns in Brittany, France. *Landscape and Urban Planning*, 50 (1/3), 119-128.

Bowler, I.R. and Ilbery, B.W., 1999. Agricultural land-use and landscape change under the post-productivist transition - examples from the United Kingdom. *In:* Krönert, R., Baudry, J., Bowler, I.R., et al. eds. *Land-use changes and their environmental impact in rural areas in Europe*. Parthenon Pub. Group, New York, 121-139.

Brandt, J. and Vejre, H., 2004. Multifunctional landscapes, motives, concepts and perceptions. *In:* Brandt, J. and Vejre, H. eds. *Multifunctional landscapes. Vol.1. Theory, values and history*. WIT Book Press, Southampton.

Brandt, J. and Vejre, H., 2004. *Multifunctional landscapes. Vol. 1. Theory, values and history*. WIT, Southampton. Advances in ecological sciences vol. 14.

Domon, G., 1994. La transformation du contexte d'exploitation et l'avenir des paysages agroforestiers du sud du Québec. *Trames*, 9, 13-19.

Domon, G., Beaudet, G. and Joly, M., 2000. *Évolution du territoire laurentidien: caractérisation et gestion des paysages*. Éditions Isabelle Quentin, Montréal.

Domon, G., Bouchard, A. and Gariépy, M., 1993. The dynamics of the forest landscape of Haut-Saint-Laurent (Québec, Canada): interactions between biophysical factors, perceptions and policy. *Landscape and Urban Planning*, 25 (1/2), 75-83.

Haines-Young, R. and Potschin, M., 2004. Valuing and assessing of multifunctional landscapes: an approach based upon the natural capital concept. *In:* Brandt, J. and Vejre, H. eds. *Multifunctional landscapes. Vol. 1. Theory, values and history*. WIT, Southampton, 181-192. Advances in ecological sciences vol. 14.

Hietala-Koivu, R., 1999. Agricultural landscapes change: a case study in Yläne, southwest Finland. *Landscape and Urban Planning*, 46 (1/3), 103-108.

Hobbs, R.J., 1997. Future landscapes and the future of landscape ecology. *Landscape and Urban Planning*, 37, 1-9.

Luginbühl, Y., 2003. Temps social et temps naturel dans la dynamique du paysage. *In:* Poullaouec-Gonidec, P., Paquette, S. and Domon, G. eds. *Les temps du paysage*. Les presses de l'université de Montréal, Montréal, 85-104.

Madsen, L.M. and Adriansen, H.K., 2004. Understanding the use of rural space: the need for multi-methods. *Journal of Rural Studies*, 20 (4), 485-497.

Meeus, J.H.A., Wijermans, M.P. and Vroom, M.J., 1990. Agricultural landscapes in Europe and their transformation. *Landscape and Urban Planning*, 18 (3/4), 289-352.

Moss, M.R., 2000. Interdisciplinarity, landscape ecology and the "transformation of agricultural landscapes". *Landscape Ecology*, 15 (3), 303-311.

Naveh, Z., 2000. What is holistic landscape ecology? a conceptual introduction. *Landscape and Urban Planning*, 50 (1/3), 7-26.

Naveh, Z., 2001. Ten major premises for a holistic conception of multifunctional landscapes. *Landscape and Urban Planning*, 57 (3/4), 269-284.

Naveh, Z., 2004. The importance of multifunctional, self-organising biosphere landscapes for the future of our Total Human Ecosystem: a new paradigm for transdisciplinary landscape ecology. *In:* Brandt, J. and Vejre, H. eds. *Multifunctional landscapes. Vol. 1. Theory, values and history*. WIT, Southampton, 33-62.

Nüsser, M., 2001. Understanding cultural landscape transformation: a re-photographic survey in Chitral, eastern Hindukush, Pakistan. *Landscape and Urban Planning*, 57 (3/4), 241-255.

Palang, H. and Fry, G., 2003. Landscape interfaces. *In:* Palang, H. and Fry, G. eds. *Landscape interfaces: cultural heritage in changing landscapes*. Kluwer Academic Publishers, Dordrecht, 1-14. Landscape series vol. 1.

Palang, H., Mander, U. and Naveh, Z., 2000. Holistic landscape ecology in action. *Landscape and Urban Planning*, 50 (1/3), 1-6.

Paquette, S. and Domon, G., 1999. Agricultural trajectories (1961-1991), resulting agricultural profiles and current sociodemographic profiles of rural communities in Southern Quebec (Canada): a typological outline. *Journal of Rural Studies,* 15 (3), 279-295.

Paquette, S. and Domon, G., 2003. Changing ruralities, changing landscapes: exploring social recomposition using a multi-scale approach. *Journal of Rural Studies,* 19 (4), 425-444.

Poudevigne, I. and Alard, D., 1997. Landscape and agricultural patterns in rural areas: a case study in the Brionne basin, Normandy, France. *Journal of Environmental Management,* 50 (4), 335-349.

Poullaouec-Gonidec, P., Montpetit, C., Domon, G., et al., 2001. *Concept et opérationalisation du paysage (phase 1): balisage du concept de paysage, des méthodes et des enjeux publics au Québec: rapport déposé au Ministère de la Culture et des Communications et à Hydro-Québec*. Université de Montréal, Montréal.

Schmucki, R., Blois, S. de, Bouchard, A., et al., 2002. Spatial and temporal dynamics of hedgerows in three agricultural landscapes of Southern Quebec, Canada. *Environmental Management,* 30 (5), 651-664.

Sooväli, H., Palang, H., Kaur, E., et al., 2003. Combining approaches in landscape research, the case of Saaremaa, Estonia. *In:* Palang, H. and Fry, G. eds. *Landscape interfaces: cultural heritage in changing landscapes*. Kluwer Academic Publishers, Dordrecht, 357-374. Landscapes series vol. 1.

Tress, B. and Tress, G., 2001. Capitalising on multiplicity: a transdisciplinary systems approach to landscape research. *Landscape and Urban Planning,* 57 (3/4), 143-157.

Tress, B. and Tress, G., 2003. Scenario visualisation for participatory landscape planning: a study from Denmark. *Landscape and Urban Planning,* 64 (3), 161-178.

Tress, B., Tress, G. and Fry, G., 2005. Integrative studies on rural landscapes: policy expectations and research practice. *Landscape and Urban Planning,* 70 (1/2), 177-191.

Vejre, H., Aaby, B. and Olwig, K., 2004. Ecological aspects of multifunctionnal landscapes in a historical perspective. *In:* Brandt, J. and Vejre, H. eds. *Multifunctional landscapes. Vol. 1. Theory, values and history*. WIT, Southampton, 159-161.

Vos, W. and Meekes, H., 1999. Trends in European cultural landscape development: perspectives for a sustainable future. *Landscape and Urban Planning,* 46 (1/3), 3-14.

Wu, J.G. and Hobbs, R., 2002. Key issues and research priorities in landscape ecology: an idiosyncratic synthesis. *Landscape Ecology,* 17 (4), 355-365.

Zonneveld, I.S., 1995. *Land ecology: an introduction to landscape ecology as a base for land evaluation, land management and conservation*. SPB Academic Publishing, Amsterdam.