Land Use Policy 54 (2016) 235–245

Contents lists available at ScienceDirect

Land Use Policy

journal homepage: www.elsevier.com/locate/landusepol

Landscape changes in Norwegian mountains: Increased and decreased accessibility, and their driving forces

Sebastian Eiter[a,*], Kerstin Potthoff[b]

[a] NIBIO—Norwegian Institute of Bioeconomy Research, Ås, Norway,
[b] Department of Geography, University of Bergen, Norway,

ARTICLE INFO

Article history:
Received 5 February 2015
Received in revised form 29 January 2016
Accepted 12 February 2016

Keywords:
Land use change
Protected landscape
Road construction
Seasonally inhabited farmsteads

ABSTRACT

Accessibility is a central issue for human activity, particularly in mountain areas. We investigate changes in physical accessibility in a Western Norwegian mountain area during the past 40–60 years and identify driving forces of changes. Changes in accessibility were measured as changes in travel time between permanently and seasonally inhabited farmsteads. Additionally, travel time from new access points in the mountains was calculated. C.75% of the investigated access routes to seasonal farmsteads have remained unchanged due to continued use or maintenance work, or been slightly improved due to development of paths into roads. In addition, new access routes have emerged as a result of road construction. Regrowth of paths due to abandonment of seasonal farming has reduced accessibility. Changes in accessibility have led to a concentration of activities in more easily accessibly parts of the study area. Documented changes in accessibility result from a complex interaction of driving forces that initiate or influence change. Important drivers interacting with road construction and abandonment of seasonal farming can be categorized as socio-economic, political and technological. However, the importance of culturally rooted commitment of local people or a small number of enthusiasts must not be underestimated.

1. Introduction

Increasing rates of landscape change are recognised in the European Landscape Convention (ELC; Council of Europe, 2000). For changes in European mountains, increased tourism and recreational use, development of infrastructure, and restructuring of agriculture have played an important role during the last century (Allan, 1986; Eiter, 2004; MacDonald et al., 2000; Tappeiner et al., 2008; Uhlig and Kreutzmann, 1994). Changes in accessibility appear to be one of the most crucial types of landscape change for the development of land use in mountain areas. Intensification of agriculture mainly occurs on more accessible and higher quality land which is located close to permanently settled farmsteads (MacDonald et al., 2000), while difficult access can explain abandonment (Eiter, 2007; Mottet et al., 2006).

To achieve the ELC's first aim of promoting landscape protection, management and planning, it is crucial to study mechanisms behind landscape changes, often called driving forces. Bürgi et al. (2004, p. 858) provide a short and illustrative definition of driving forces as 'the forces that cause observed landscape changes'. However, driving forces are complex: A particular landscape change is probably rarely connected to only one driving force, unless on a very broad scale. Moreover, causes and effects may not always be identifiable, e.g. due to lack of available data, or because of interaction or mutual influence among different forces (Eiter and Potthoff, 2007). Mander and Jongman (1998, p. 150) provide an illustrative example, whose complexity becomes especially clear if one reads the emphasised parts of the quotation only:

> 'During the last few years, rural landscapes in Europe have changed significantly. **Due to** restructuring of agriculture in the European Union (EU) countries and **radical socioeconomic changes** in eastern and central Europe, **landscape change will continue**. **This stimulates interest** for landscape ecologists **to study the** processes connected with such rapid **development and to analyse its socio-economic** and ecological **consequences**' (emphasis added).

In other words, socio-economy drives landscape change which in turn changes socio-economy. Landscape change may thus not only result from driving forces, but also exert driving forces that influence further change. Finally, forces may not only result in landscape changes but also prevent them (Eiter and Potthoff, 2007; Jones, 2010: 'counterforce'). Scale is another issue that challenges the study of driving forces. Bürgi et al. (2004) show that driving

* Corresponding author at: NIBIO—Norwegian Institute of Bioeconomy Research, P.O. Box 115, 1431 Ås, Norway.
E-mail addresses: sebastian.eiter@nibio.no (S. Eiter), kerstin.potthoff@uib.no (K. Potthoff).

http://dx.doi.org/10.1016/j.landusepol.2016.02.017
0264-8377/

forces can act on a large variety of spatial scales—from square meter to continent.

Norwegian mountain areas have provided important resources for farm households for many centuries (Almås, 2004a). Livestock has been moved up to seasonally inhabited farms (seasonal farms; Norw.: *støler/setrer*) for summer grazing (Reinton, 1961). Movement has commonly occurred via paths between permanent and seasonal farmsteads. An extension of the road network, including direct access to seasonal farms, since the mid-19th century and decay of old paths, has changed accessibility of seasonal farms.

Accessibility has been studied from quite different points of view, for example, physical, legal or 'perceived' accessibility (Millward, 1991; Koppen et al., 2014). Physical accessibility might be the most fundamental type of accessibility. It refers to horizontal and vertical distances that have to be overcome to access a locality. Steepness or roughness of the terrain, and mode of transport influence physical accessibility as well. Travel time can be used as an overall measure of these factors, and thus of physical accessibility as such. Legal accessibility refers to the (non-)occurrence of restrictions of access imposed by laws or regulations. Access can be freely allowed to the public, be restricted to certain groups or means of transport, or prohibited. Legally restricted access can be physically manifested, either explicitly through material artefacts (signs), obstacles (walls, fences), or – implicitly – through a lack of infrastructure development. Perceived accessibility results from a combination of physical and legal accessibility of an area, and the cultural, social and socio-psychological background of the potentially interacting human individual. An individual may perceive an area as inaccessible due to, for example, a sense of unsafety, or absence of tradition, experience or knowledge (Koppen et al., 2014), although the area could be reached easily in terms of distance, and without legal restrictions.

In this study we focus on changes in physical accessibility in a Norwegian mountain area during the past 40–60 years, starting approximately when the first road crossing the mountains was completed. Our main focus is on changes in accessibility for farmers; however, since touristic use of our study area has become quite extensive throughout the 20th century, changes in accessibility for tourists are considered as well. The study aims to answer the following questions: Which changes in accessibility can be documented? What are major driving forces and what characterises them?

2. Dealing with the complexity of driving forces

A large number of approaches and theories have been used to explore and explain landscape change (Qasim et al., 2013). Starting with the influential work by Brandt et al. (1999) we have selected a set of studies to review, that include a broad, systematic and thorough treatment of the term 'driving force', at the same time as we consider them being representative for particular approaches. We present these approaches according to their authors' understanding of driving forces: Some concentrate on either structures or processes whereas others include both (Table 1).

2.1. Process-based approaches

Antrop (2004, 2005) offers a process-based approach to driving forces. The author identifies four main driving forces: urbanization, effects of transportation networks, globalization and calamities, which are all processes of landscape change. Processes can be interlinked as, for example, new transport networks and urbanization: Areas opened up by new infrastructure change quickly (Antrop, 2005); they enable and attract the development of new settlements, i.e., urbanization.

Primdahl and Swaffield (2010) agree on the relevance of urbanisation which they identify as a key driving force of changes in agricultural landscapes. A second key driver for them is processes of change in agricultural production systems, which – on a global scale – are driven by market liberalisation, reduced transportation costs, reduced prices for agricultural products, and deregulation of agricultural policy (Primdahl, 2010). A third example of processes as driving forces is given by Wang et al. (2008) who propose socioeconomic development and climate change as most important driving forces of agricultural land use changes on the Tibetan Plateau during 1990–2000. All studies presented so far identify driving forces through reasoning; however, they differ in size of study areas and in methods to identify landscape change (Table 1).

2.2. Structure-based approaches

Serra et al. (2008) use a structure-based approach to investigate driving forces of land-cover and land-use change on a regional scale. They identify land cover changes through remote sensing, followed by multiple logistic regression to identify 'independent variables' (read: driving forces) that are most important for the observed landscape changes. Variables included are structural parameters (mean temperature, altitude, slope, landholders' age, land price, etc.); however, some of them originate from processes of landscape change. For instance, limits of areas affected by forest fire result from burning, and borders of protected areas are outcomes of political processes. Serneels and Lambin's (2001) analyses of proximate causes of landscape change concentrate on structural parameters such as distance to roads, land tenure and altitude. However, percentage of change in population density is a process variable. Moreover, processes as driving forces are generally acknowledged in the overall description of changes in the study area, e.g. natural succession or changes in land tenure. Gellrich and Zimmermann (2007) analyse regional-scale patterns of agricultural land abandonment through spatial statistical modelling. Similar to Serneels and Lambin (2001) they use mostly structural variables, supplemented with the percentage of population change as a process.

Similarly structure-based approaches have been applied by de Koning et al. (1998) and by Verburg and Chen (2000) to explain current land use patterns on national and regional level. The authors have tested the explanatory power of structural variables, as for example, slope, soil texture, altitude and population, in multiple regressions based on different grids. Although both studies focus on current land use patterns and not on landscape changes, the authors point out the relevance of their analyses for developing models of future landscape changes, and in this case the structural independent variables can be considered to be the driving forces of change.

2.3. Approaches integrating processes and structures: categorisation

A way to deal with driving forces that includes both structures and processes is to categorise or group the forces. For example, Brandt et al. (1999) call technology, natural environment, socioeconomic environment, policy, and culture for being five 'key driving forces'. The authors show how different processes of landscape change in rural areas are influenced by driving forces that belong to these categories. Other researchers have adopted these categories (Bürgi et al., 2004; Hersperger and Bürgi, 2009; Schneeberger et al., 2007; see Table 2 for examples).

Kristensen et al. (2009) apply a similar categorisation approach that classifies drivers of change into 'Economy and market', 'Transport and infrastructure', 'Policy and legislation' and 'Technology and land improvement'. Busch (2006) distinguishes between seven