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Vulnerability and resilience of cultural landscapes

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Introduction

The term vulnerability derives from the Latin *vulnerare* which means 'to wound'. Vulnerability raised the question as to how easy it is to be wounded or injured. As regards cultural landscapes, vulnerability may be usefully considered under three broad headings: (1) exposure to pressure, i.e. factors that adversely affect the functioning of the system, including unusual disturbances; (2) sensitivity to these factors and capacity to cope with them; and (3) resistance or capacity to absorb changes in pressures and disturbances while maintaining functionality. Vulnerability of cultural landscape ecosystems is linked to their degree of dependence on the maintenance of the management practices that have shaped them (see Figs. 1-10).



Fig. 1. Terraced slopes with olive-groves and horticulture near Loriga, Portugal. J. Jansen, 1996.

Once an ecosystem has been modified, resilience, which is complementary to vulnerability, comes into play. By resilience is meant the speed and potential for restoration of a favourable balance and the degree to which a system returns to its former state after it has been disturbed or displaced from that state. If the features (species and other characteristics) that have been lost due to a particular set of pressures return on the removal or reduction of the pressures in question, the system is resilient and the degree of resilience is reflected in how fast the balance is restored.

The resilience of a cultural landscape ecosystem depends on the type of management, the species and the physical environment (soil, water availability, and climate). The resilience of 'natural' ecosystems lies in their capacity to adapt to disturbances, whereas the resilience of cultural landscape ecosystems depends on the return to original or similar management practices. In general, the more culturally influenced a system is, the more vulnerable and the less resilient it is to changes in management. Grazed grasslands are usually less vulnerable and more resilient than meadows that need more careful management. Some cultural landscape ecosystems are characterised by strong man-made elements such as terraces, stonewalls or hedgerow



Fig. 4. Heathland used for summer grazing in Penhas da Saúde, Portugal. The aspect is largely defined by *Erica australis*, *Erica umbellata* (both purple flowered), *Erica arborea* (white flowered), *Calluna*, *Cytisus oromediterraneus* and *Halimium alyssoides* (both yellow flowered). J. Jansen, 1992.

human activity, to the original natural system.

In general, light-demanding and short-lived plant species survive the new management regimes. Trees and tall shrubs, on the other hand, have low resilience capacity in the new milieu, undergo reduction and may not be able to tolerate the new conditions and so disappear. Through maintenance and re-enforcement of a particular set of conditions, species assemblages are formed that become characteristic of particular cultural landscapes and are dependent on management as well as the usual ecological factors such as climate and soil conditions.

The progression between the various steps that make up the typical sequence of landscape development has been

greatly accelerated in recent years. The sequence typically goes through the following stages: pristine wilderness, agricultural landscapes and agro-industrial landscapes that are normally accompanied by large-scale urban landscapes. Beginning in the later phases of the nineteenth century and accelerating, at times almost exponentially, landscapes that previously stayed relatively stable over periods that spanned several human generations, are experiencing disturbances and changes in management of unprecedented intensity. Since the Industrial and later the Green Revolution, which resulted in increased food production through the breeding of new plant varieties and the application of modern agricultural techniques, continuity of manage-



Fig. 5. Semi-natural, unfertilized pasture at Bulandet, western Norway, with rarities such as Scilla verna. Such pastures are vulnerable to abandonment. M. H. Losvik, 2004.

ment has been replaced by discontinuity. In many instances, the changes brought about pressures that were beyond the resilience/tolerance levels of several of the floristic and faunal elements with the result that vulnerable species that could not adapt to the radical changes were lost; similarly, what were perceived to be economically non-profitable structures and practices were removed and allowed to lapse, respectively.

Traditional landscapes were closely adapted to local conditions. Traditional farming practices responded, out of necessity, to local conditions such as climate, topography, hydrology and soil types.

This sensitive use of natural resources produced a patchy landscape. Certain

soils, for instance, were more suited to the high demands placed on it by arable crops while others were more suited to hay making or extensive, year-round grazing. The result was a complex and diverse landscape, even at the small scale level of local communities. Nutrient and energy cycles were locally rooted, as is well exemplified by the infield/outfield system. In contrast, modern farming relies more and more on remote inputs and the outputs are often destined for distant, global markets. The result is landscape uniformity through large-scale intensification. Whereas traditional landscapes exhibited diversity and had a strong regional character, modern landscapes have increasingly comparable structure and there tends to be a sameness in the



Fig. 6. Scilla ramburei ssp. beirana, an extremely rare Lusitanian endemic and Habitat Directive, Annex IV species, in an irrigated hay-meadow at Videmonte, Portugal. J. Jansen, 1996.

flora and fauna as a result of the use of industrial-scale management practices that involve use of herbicides and pesticides to control unwanted species that inevitably find favourable conditions within monocultures. To what extent these processes are really affecting our long-term essential resources is a question that is seldom asked but which must be addressed before more irreparable harm is done to the European and global environments.

A further aspect to be borne in mind is that the natural conditions under which both natural and cultural landscapes developed are often no longer available and, furthermore, present availability is no guarantee for the future in that human-induced climate change on the global scale and genetic manipulation on the nano scale may result in changes that are irreversible. On the basis of current scientific knowledge, we cannot predict what the outcomes and impacts will be of ongoing change on the quality of our lives and environment. Perhaps such problems, in the words of Einstein, 'cannot be solved at the same level of thinking we were at when we created them'.

Vulnerability and resilience and the processes of intensification and extensification

Although locally complex, human forces that determined cultural landscapes in the past were based on relatively simple economics. Decisions on management were taken locally and based on the productive capacity of the cultural landscape ecosystems. With increasing globalisation and dependence upon remote inputs and market policies, factors forcing cultural landscapes become more complex while the ecosystems themselves lose their complexity. Changes are implemented to improve productivity at both field and landscape level and, furthermore, the changes, and manner in which they are to be implemented, are often remotely determined and with little knowledge of the situation on the ground.

In Europe, two divergent trends in land-use management can be observed: extensification and intensification. In marginal areas there is a progressive development from open to more closed landscapes. In productive areas, on the other hand, there is loss of structures, e.g. hedges and terraces, as a result of increasing intensity. The result may be a total system loss and/or a partial loss that involves a reduction in biodiversity, traditional features and the overall resilience of the system.

An example of the former is urban expansion at the expense of traditionally cultivated land. In former days, these areas were often protected because the urban inhabitants depended on them for food. As a result of globalisation, dependence on local and even regional production has decreased to the point that it is no longer necessary that agriculturally productive land be located near



Fig. 7. Libelloides longicornis, a yellow-and-black winged dragonfly-like insect of the Ascalaphidae family prefers dry and open grasslands. Serra da Estrela, Portugal. J. Jansen, 1997.

cities. The adverse consequences are sometimes partly counterbalanced by having protected areas close to urban centres with high population densities for leisure purposes. Traditional landscapes may in these contexts be given a new lease of life but it is certainly a challenge for both the conservation movement and the construction industry to utilise the potential thereby presented. Even if old stone walls, terraces, fruit trees and large, old pollards are preserved, biodiversity will nevertheless probably decline as these features are no longer managed as heretofore.

As many old, agricultural areas of Europe are being converted into 'set-aside' or are exposed to intensification, there is a collapse in the species popula-

tions that were characteristic of the cultural landscapes in question. In particular, characteristic species of dry, moist and wet areas and of poor soils in both lowland and upland/alpine zones that were dependent on agricultural management are seriously reduced in number and frequency all over Europe. Examples of managed and species-rich, old cultural landscapes will inevitably be conserved, but even with best conservation and management practices, fragmentation and isolation will eventually take their toll.

Intensification

Intensification normally leads to system loss over time. In order to increase pro-

duction, a farmer raises nutrient levels, often through excessive application of artificial fertilizers or organic manure from intensive husbandry. Other forms of intensification include use of land in a highly intensive way, especially for arable farming, without an intervening fallow period. Furthermore, intensification normally involves removal of obstacles to efficient use of large machinery, namely stone-walls, hedges, small ravines, stone clearance heaps, solitary trees and irrigation channels. Diversity is automatically reduced as former diverse agricultural landscapes are transformed into uniform landscapes in which conditions are optimised, often for single crop production. In recent decades, this is a widespread phenomenon in most parts of Europe. Nutrient-poor, semi-natural systems are destroyed and also landscape features that contributed to both landscape biodiversity and scenery. Intensification processes have also resulted in severe environmental problems such as atmospheric deposition of ammonium sulphate, nitrogen enrichment of ground waters, and pollution of rivers and streams.

Extensification

Land abandonment or partial abandonment represents another major land-use change that affects cultural landscapes of Europe at present. Whereas intensification mostly occurs in lowlands and near densely populated areas, land abandonment occurs mostly in areas that are marginal from the viewpoint of present-day mechanised farming. Such areas are usually distant from centres of population. Outfield pastures, whole farms and large districts are thus abandoned or the land-use so reduced that it is effective abandonment even if still farmed. Following

land abandonment, ecological succession occurs that involves encroachment by scrub and eventually forest under most European climatic regimes.

Species that are adapted to management regimes associated with cultural landscape ecosystems are usually out-competed by invasive species including species of neighbouring natural or semi-natural ecosystems.

Each species or group of species shows different levels of tolerance to abandonment so it is only with the passage of time that vulnerability and resilience can be evaluated. Some species are rather tolerant and may survive for a long time after abandonment, even if their populations reduce gradually so that the vegetation changes slowly and loses its relationship to the parent vegetation. Eventually, even the most tolerant species may disappear. The Lüneburger Heide in central Europe is a good example of such developments (see Küster; this volume).

Forest species – native or non-native but highly invasive (e.g. *Acacia* spp. in parts of south-western Europe) – have a strong tendency to invade former cultural landscapes. A progressional series can often be seen from the margins to the centre, with minimal invasive influences away from the margins. The speed with which this process takes place is generally site dependent and normally takes longer where conditions are generally unfavourable for plant growth (e.g. areas with dry climate or poor soils, and generally where harsh conditions due to severe frosts and strong winds prevail). In any case, abandonment will finally result in total system loss, as former agricultural landscapes are replaced by new forest systems. Where soil and climate are especially suitable for agriculture, the new forest cover may be more species-rich than the former cultural



Fig. 8. A rye field with an attractive border of *Cytisus* (broom) in Planalto de Videmonte, Portugal. J. Jansen, 1996.

landscape. On poor soils or in dry sites, however, where hay meadows and non-fertilised pastures once predominated, the semi-natural vegetation that results from natural succession has normally much lower biodiversity and tends to be more uniform in character.

Extensive afforestation is often considered the best option where the indigenous farming populations are in severe decline and there is resultant large-scale land abandonment. In Portugal, for instance, areas once characterised by traditional farming now carry vast pine and eucalyptus plantations. This was considered an economic success, especially as Portugal became a timber exporting country. Within a relatively short period, however, these modern plantation landscapes proved to be extremely vulnerable to wildfires, caused not only by natural factors but also by attempts to defraud and social

misbehaviour. The consequences have been serious and far-reaching and also persistent as in the post-fire erosion landscapes, pine and eucalyptus are rather resilient compared to most other species.

In the absence of carefully thought-out management practices, the cycle of erosion, land slides, obstructed rivers, risks of floods, water pollution and loss of biodiversity, will remain unbroken. The solution lies in an integrated ecological, economic and social policy for tackling marginal mountainous areas. In cultural landscapes with great natural and human-induced diversity, such as the Parque Natural da Serra da Estrela in the centre of Portugal, an integrated programme that includes revitalisation of the small-scaled, countryside economy, with its sustainable agriculture and cattle breeding, linked to water and landscape management and



Fig. 9. Traditional farming practices are still practised on this infield area at Gripne, western Norway, though increased use of fertilisers has resulted in lower biodiversity. In the background abandoned outfield areas are increasingly encroached by deciduous trees. M. H. Losvik 2005.

tourist amenities, is the best hope for the future (e.g. Wienerwald, Muhar et al.; this volume). What once was regarded as old-fashioned may become a viable option, albeit modified to suit present conditions. It may also be an answer to the countryside exodus and land abandonment that so seriously affects the viability of rural areas.

Finally, it is important to sound a note of caution. Restoration of former management systems may result in many of the characteristic species increasing their populations to former levels. On the other hand, other cultural landscape species, and especially vulnerable or so-called Red List species, may not succeed in re-establishing themselves for a variety of reasons such as over-enrichment of soils (especially where species require oligotrophic conditions). Inevitably, biodi-

versity declines and the defining characteristics of landscapes are lost.

Conclusions

Even though European landscapes are in a process of transformation on a scale, speed and magnitude that greatly exceed any changes in the past, it is important not to be discouraged, but search for possibilities of building up sufficient capacities, both intellectually and physically, to mitigate and even reverse further landscape deterioration.

A solution may be contained within the concept of sustainability. In general, it is assumed that sustainability of the earth's system is supported by three pillars that can be illustrated by a triangular relationship, namely the social, economic, and ecological capital or the surrogate expres-



Fig. 10. An area under traditional farming in Tveita, Western Norway. The flat area consists of 'improved' land, the sloping terraces carry hay-meadows while the upper terraces are abandoned and colonised by trees. M. H. Losvik, 2005.

sion 'people, profit, and planet'. Within these concepts, a cultural landscape is a sustainable managed portion of the planet in which the well-being of its peoples, the sound economic functioning of its household and the ecological functioning of the ecosystem are well balanced, especially in the long-term perspective. Future research should focus especially on the interface between the sides of the triangle. Such multidisciplinary research presents a considerable challenge for the rather different traditions of the various disciplines involved.

Without the support of consumers and general appreciation of the important issues at stake, sustainable cultural landscapes cannot be guaranteed. Major changes are required not only in attitude but also in behaviour of citizens. Citizens sensitive to ecological, economic and

social impacts of their consumption habits are able to make choices for a lifestyle that supports environmental friendly land use. Consumers therefore need both scientific and moral support. But, even if there is a willingness to change behaviour and lifestyle at the individual level, without political will at the governmental level a decisive shift to sustainable management is unlikely. Support mechanisms are needed, for instance, to encourage sharing of common goods such as clean air, water, and soil and cultural landscapes that embody so much of our common European heritage.

During the last 10–15 years several important EU Directives have been activated, e.g. the Bird, Habitat, Nitrate and Water Directives. It takes substantial change of attitude and indeed sacrifices, however, to change consumption pat-

terns. Many consumers have an empathy with nature and cultural landscapes, but when there is a choice between high-priced nature-friendly quality food products and low-priced industrial food products they often choose the latter. Unfortunately, if environmental friendly behaviour entails extra costs and opportunistic behaviour brings extra benefits, then the latter all too often wins out at the expense of the common weal.

Much has to be done, especially at the trans-national European and global levels. The price of food produced in intensive systems and/or distant from the point of consumption takes no account of the environmental burden connected with production and transportation. That

there is such a burden – substantial air, water and soil pollution, adverse effects on biodiversity and loss of scenic beauty and cultural heritage – should be better highlighted in order to raise the awareness among the general public of the full consequences for the quality of life. On the other hand, it is clearly important that traditional farmers, by whose work cultural landscapes and semi-natural biotopes are maintained, are appropriately rewarded at EU and national levels for this important service to the European and global communities.

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