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Haiyun Xu

*University of Copenhagen, Department of geosciences and natural resource management*

Tobias Plieninger

*University of Copenhagen, Department of geosciences and natural resource management*

Jørgen Primdahl

*University of Copenhagen, Department of geosciences and natural resource management*

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## **A systematic review of landscape corridor conservation and management in Europe**

Haiyun Xu, Tobias Plieninger, Jørgen Primdahl

*University of Copenhagen, Department of geosciences and natural resource management*

### **Introduction**

Since EU Commission initiated Green Infrastructure (GI) strategy, an important step has been taken to help public to understand benefits of nature, such as providing food, clean air, and water resource. Besides, Green Infrastructure plays an important role in climate regulation, stormwater prevention, sustaining biodiversity. And its recreational function is also valuable for human society. Therefore, it is necessary to invest more resources in Green Infrastructure to develop, maintain and sustain it (Green Infrastructure COM, 2013).

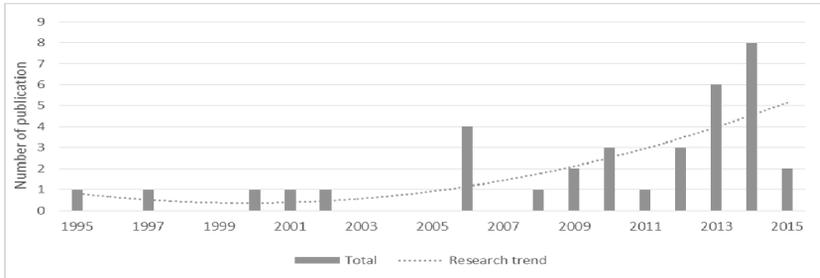
Green Infrastructure is planned as a strategically network of natural and semi-natural areas with environmental functions and its elements are designed and managed to deliver a wide range of ecosystem services it (European Environment Agency, 2011), which also provide solutions for urban and rural landscape conservation and sustainable development under the background of rapid and fundamental transformations in European landscapes.

Landscape corridor is identified as thin strips that connect isolated patches (Joshua J. T. et al., 2002). It has similar features such as connectivity, functionality, integration, and can be considered as a part of Green Infrastructure network from systems thinking, ecological thinking and social thinking. Landscape corridor can be defined as the linear landscape elements with cultural properties that represent the combined works of nature and of man. It is important due to its connectivity as well as its scenic, cultural, social, economical, ecological and recreational functions. Comparing with the concept of Green Infrastructure, we can find that Landscape corridor (LC) shares many common features with GI, but it also has its own properties gained from its unique linear form, such as connectivity and/or forming boundaries.

### **Background**

The status of the research relevant to landscape corridor in Europe can be categorized from spatial and temporal perspectives. To reveal the temporal characteristics of the research on landscape corridor, literature were collected and the numbers of publications in each year were plotted in Figure1. From the

publication, it can be seen clearly that the landscape corridor becomes more and more important for the past two decades. Another noticeable trend is that more attention has been paid to the ecological value of the landscape corridor.



**Figure 1. Trend of landscape corridor publication**

Landscape corridor has various relevant concepts and types including cultural routes, cultural corridor, greenway, ecological corridor, and ecological network.

In the cultural aspect, cultural corridors and cultural route were identified by ICOMOS (International Cultural Tourism Charter of ICOMOS, Mexico, 1999). They were defined as a system of cultural values and historical ties created by cultural exchange and dialogue between the parties. In recent years, they are seen as a cultural phenomenon that reveals the new political, economic and social opportunities for the development of the countries such as in Southeast Europe (Shishmanova, 2015). They can also become a comprehensive cultural and tourist product, comprising cultural values and the tourist, transport and information infrastructure (Richards, G., 2008).

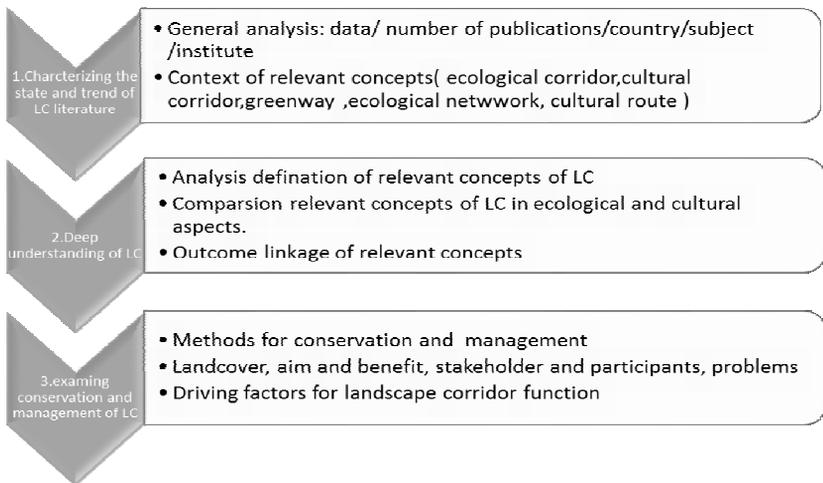
The concept of greenway was firstly defined and developed in the United States (Little, 1995) (Fabos, J. Gy., 1995) it was further developed by the European Greenways Association later (Lille Declaration, 2000). An ecological network is a representation of the biotic interactions in an ecosystem, in which species are connected by pairwise interactions and ecological corridor can be regarded as a component of ecological networks (Rob Jongma et al., 2004). The Pan-European Ecological Network (PEEN) was established in 1995 under the agreement of 53 European countries. Nowadays, 42 national and regional ecological network initiatives have been developed across Europe, but they are at varying stages of implementation (Zingstra et al., 2009). And it is also considered as a critical element for landscape policy design (Kettunen et al., 2007).

The similarities and differences between those five relevant concepts have yet been carefully compared and they are not studied under the framework of linear cultural landscape. Therefore, it is necessary to perform a systematic review and reconstruct the internal connections between these concepts. Finally, we summarize the 5 relevant concepts of landscape corridor from two aspects, the cultural aspect and ecological aspect based on their function.

This review aims to study characteristics of the 5 relevant concepts of LC in both cultural function and ecological function, carry out the comparison between the 2 function and explore their linkages and provide a systematic review of landscape corridor and their conservation and management across Europe through identifying, comparing relevant concepts and summarizing methods based on a wide variety of academic resources regarding landscape corridor.

### Method(s)

This study is conducted with a descriptive-analytical method to achieve the objectives, the following methodology (as illustrated in figure 2) is presented.



**Figure 2. Objectives and methodology**

There are 80 cases currently included in the analysis of the state of research on landscape corridor. Since this study focuses only on the European experience, all the cases reviewed are from the countries or regions within Europe. Finally, 80 landscape corridor cases on management and conservation are from 22 countries for our analysis.

## Results

This paper studied 80 cases on landscape corridor conservation and management in both cultural and ecological aspects. The cases were founded in each year since 1995. The result of our final case studies is from 22 European countries. 67% of the cases were from Italy, Spain, Portugal, Germany, Turkey.

### Landcover contexts

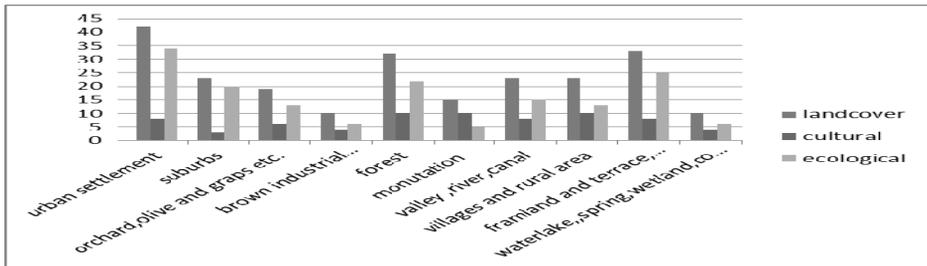


Figure 3. Number of landcover styles mentioned by cases

The case study areas were diverse landscapes which included 10 different landcovers (SD=201.1). The situations on cultural or ecological function landscape corridors were similar with the general trend. Urban settlement, forest, villages and farmland (terrace, crops etc.) were the landcover styles mentioned most frequently (more than 40%); brownfield like abundant industrial area or mine area had least frequency could be unique cases. For instance, Rocchette-Asiago railway greenway in Italy were located on abundant mine area which directly related to the aims for local landscape corridor planning aim.

### Aims and benefit

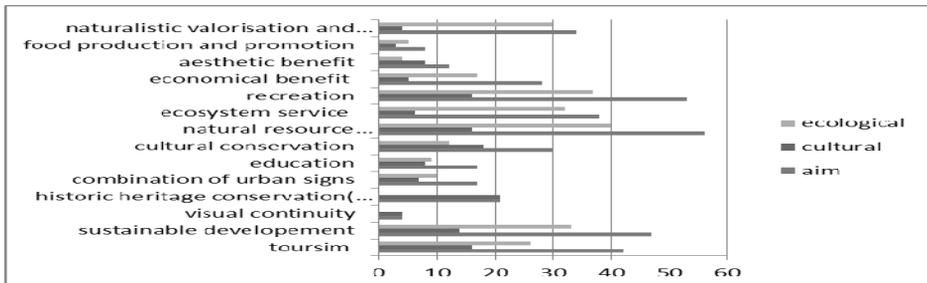


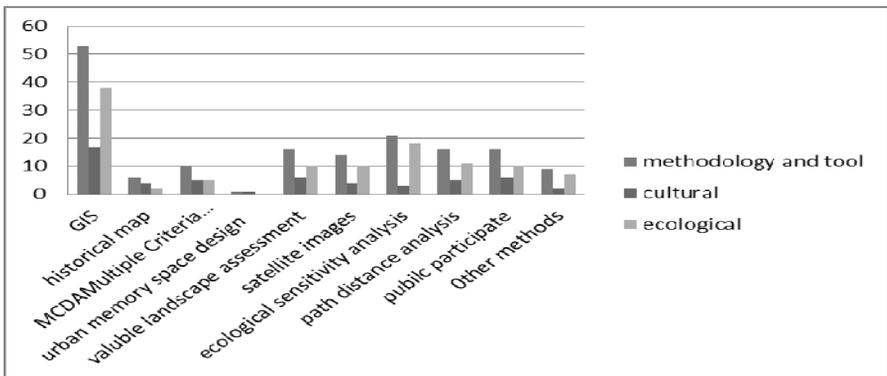
Figure 4. Number of aims and benefit mentioned by cases

Major cases reported nature resource conservation(70%) and recreation (66.25%) were the most important aim and benefit for landscape corridor conservation. Toursim and local sustainable development also were considered as visual aims and benefits (52.5% and58.75%). However, due to diversty of conservation function, there were different aim and benefits in cultural and ecological landscape corridor.

For cultural landscape corridor, historical sites and heritage protection was the most frequent target and benefit metioned by cases (26.25%).

While the most common aims for ecological landscape corridor was nature resource conservation (50%).The frequency of toursim, recreation, sustainable developement,education,cultural conservation as aims and benefits were similar. Besides heritage, the gap between naturalistic valorisation and reclamation, visual continuity distinguished cultural landscape corridor from ecological landscape corridor. Food production was the minimal aims focused on,but it appeared in both cultural and ecological landscape corridors. In the case Alto DouroWine Region cultural greenway in Spain, promotion of local vineland and increasing production of graps and wine also was main aim and benefit besides archaeological wine sites, historical wine caves protection.

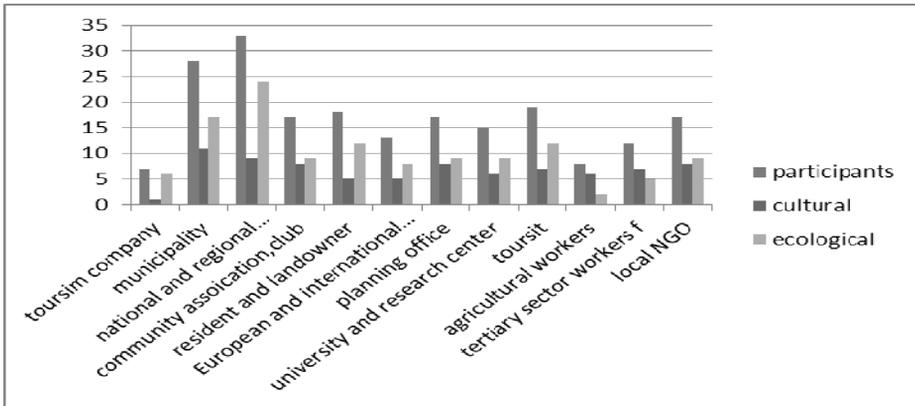
**Methodology and tools used in planning process**



**Figure 5. Number of methodology and tools mentioned by cases**

Comparing with traditonal design apporach, Geographic Information System (GIS) were widely used as the main trend methodology in majority of cases(66%) . Based on GIS, more than 8 tools and methologies were mentioned by the landscape corridor planning and protecting process.Public participate planing and valuble landscape assessment were common approaches in both cultural and ecological cases.Composite approach were used in major cases depending their own function features.

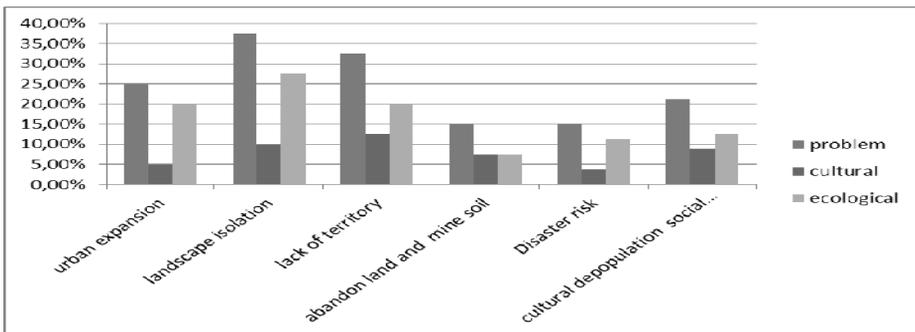
## Stakeholder and participants



**Figure 6. Number of stakeholder and participants mentioned by cases**

Stakeholders including decision makers and participants effects the planning and management process in landscape corridor. These cases involved 12 various stakeholders (SD=3,21). The most common items were municipalities (35%) and national or regional government (41%), which could be considered as decision makers. Cooperation between official department and other organisations (planning office, university and research center ,etc.) and participants(resident,tourist etc.) were also frequent in cases.

## Problems and barriers



In the problems landscapes corridor faced with, landscape isolation (25%), lack of territory(32.5%), urban expansion(37.5%) were the main menaces for local area both in cultural and ecological and landscape corridor. Additionally, the difference between cultural and ecological landscape corridor also were percentage of disaster risk and cultural depopulation/social loss.

## Conclusion

In cultural landscape corridor cases, the most frequent driving factors were management (count 409) and participation (count 513). The cooperation between local government, research center, and landowner was the main model in successful cases. In ecological corridor cases, a well-documented inventory of data and resource analysis were regarded as the key issues effects landscape corridor performance.

Based on cases, successful performance of landscape corridor mostly depends on:

- a) A good data collection and analysis both in ecological and cultural aspects.
- b) Public participation and social cooperation.
- c) Government support for policy and funding.

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