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Assessment of the resilience of socio-ecological production landscapes and seascapes: A case study from Lefke Region of North Cyprus

Gulay Cetinkaya Ciftcioglu

European University of Lefke, Faculty of Architecture, Department of Landscape Architecture, Mersin 10, Turkey

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ABSTRACT

The purpose of this study is to assess the resilience of *socio-ecological production landscapes and seascapes* (SEPLS) of Lefke Region in North Cyprus in the face of disturbance factors (e.g. drought, urbanization and land abandonment) by adopting a set of indicators. The main objectives of the study include measurement of the respective resilience of the ecological, social and agricultural systems of the SEPLS by using relevant indicators. The method of the study consists of three parts: (i) conceptualization of the resilience of the SEPLS of Lefke Region to address the key systems (ecosystem, agricultural and social), their hierarchical structures, components and interrelations; (ii) development of a set of suitable resilience assessment indicators for these systems; (iii) for the development of resilience assessment indicators a participatory approach was designated to collect the relevant data. Accordingly, a multiple-choice questionnaire – consisting of 5 choices – was prepared and relevant data were collected from December 2015 to March 2016 in 12 villages through personal interviews with 106 respondents.

The respondents have expressed their preferences by selecting the most suitable choice in 5 which were ordered from the lowest to the highest degree of resilience (1–5 point scale). The results of the evaluation revealed that the average values (importance) of the ecological, agricultural and social resilience are respectively 2,87 (low), 3,44 (moderate) and 2,53 (low) out of maximum 5-points. The overall resilience of the SEPLS was estimated to be low with a 2,94 magnitude. Finally, some conclusions (e.g. integrated landscape management) for strengthening the resilience of the SEPLS in Lefke Region in terms of biodiversity conservation, agricultural production and sustainable livelihood development were drawn based on the major findings of the study.

It is expected that the findings and conclusions of this study can draw attention of policy makers and natural resource managers on building and strengthening the resilience of the SEPLS of Lefke Region in terms of biodiversity conservation, sustainable agricultural production and livelihood development.

1. Introduction

Over the past decades the changes in ecosystems resulting from human activities have been becoming more obvious than ever. Although health and wealth have improved, the social and geographic distribution of benefits delivered by ecosystems to human populations remains uneven. Learning how to manage feedbacks between ecosystems and humans is vital if we are to move toward a more sustainable world, in which the health of ecosystems and human wellbeing are improved and ecosystem services are distributed more equitably for current and future generations. As every ecosystem on Earth is influenced by human actions; the environment can be best understood and studied as a *social-ecological system* (Collins et al., 2011).

Meanings of social-ecological landscapes and socio-ecological production landscapes and seascapes (SEPLS)

Social-ecological systems can be defined as linked systems of people and nature in which people depend on nature and nature is influenced by people (Berkes et al., 2003; Matthews, 2006). There are a variety of social-ecological systems (Young, 2006) such as *social-ecological landscapes*. A social-ecological landscape is a complex adaptive system that can be characterized by its capacity to self-organize and adapted on the basis of past experience and substantial uncertainties (Levin, 1998; Pahl-Wostl, 2007; Biggs et al., 2012). Social-ecological landscapes link cultural and biological diversity and also represent productive landscapes that people have developed, shaped and maintained sustainably over a long time (Gallopín, 2006). *The goal of a social-ecological landscape is the*

E-mail address: gcetinkaya@eul.edu.tr

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wellbeing of a community, non-human life forms, and their geophysical environment (Halliday and Glaser, 2011). A social-ecological landscape system consists of ecological and social systems (Binder et al., 2013) that provide essential ecosystem services to society (e.g. supply of food, fiber, energy and drinking water) (Berkes and Folke, 1998; Unnasch et al., 2008). All components of ecological and social systems are functionally linked in complex social-ecological landscapes (Pickett et al., 1997). Social-ecological landscapes develop continually depending on particularly their exposure to disturbances, their resilience, adaptive cycle and adaptive capacity in the long-term (Charette-Castonguay, 2014). These landscapes have adapted to local geographic and socio-economic-cultural conditions. Therefore, various names are used for them across countries and languages, *ahupua'a* in Hawaii, *Satoyama* in Japan, *Dehesa* in Spain, *mauelsoop* in Korea and *muyong* in the Philippines (UNU-IAS et al., 2014). Further, the scholars emphasized that the term '*Socio-Ecological Production Landscapes and Seascapes (SEPLS)*'has been used to refer all kinds of these landscapes. Accordingly, the term SEPLS is replaced by 'social-ecological landscapes' further in the text. Resilience of SEPLS provides diverse ecosystem services for human wellbeing; therefore, building and enhancing the resilience of SEPLS can contribute to conservation of biodiversity, security of food production and sustainability of livelihoods.

Understanding the concept of resilience

The concept of resilience was first introduced in 1973 by C.S. Holling as *the propensity of a system to retain its organizational structure and productivity following a perturbation* (Holling, 1973). Various definitions for resilience have been made until now. Basically, the term of *resilience refers to the capacity or ability to deal with disturbances or change without altering the essential characteristics of the system* (Plieninger and Bieling, 2012). Resilience does not necessarily mean that the system will look just as it did before a disturbance. It will maintain its functions, but individual parts of the system may have changed (adapted) to new conditions in the environment (Longstaff et al., 2010). Resilient systems have the capacity to absorb disturbance and reorganize while undergoing change so as to still retain essentially the same function, structure, identity, and feedbacks (Walker and Meyers, 2004; UNU-IAS, 2013; Unnasch et al., 2008). Central features of resilience include (i) the ability of a system to absorb or buffer disturbances and still maintain its core attributes; (ii) the ability of the system to self-organize; and (iii) the capacity for learning and adaptation in the context of change (Berkes et al., 2003). The concept of resilience has emerged as one conceptual framework with which to understand change and the multiple cross-scale interactions in social-ecological systems (Gunderson and Holling, 2002; Berkes et al., 2003). Thus, the resilience approach provides a framework to better understand the complex social-ecological systems. The approach contributes to maintaining the productive capacity, health and longevity of the system (Wheatbelt, 2013).

Resilience of socio-ecological production landscapes and seascapes (SEPLS)

Resilience of SEPLS includes resilience of ecosystems and social systems. *The resilience of an ecosystem relates to the functioning of the system, rather than the stability of its components, or even the ability to maintain (recover) a steady ecological state* (Adger, 2000; Pimm, 1984). Resilience is the key to biodiversity conservation and diversity itself enhances resilience, stability, ecosystem functioning and sustainability in the wider sense (Adger, 2000). *The resilience of a social system refers to the capacity of a community system, or part of that system, to absorb and recover from disruptive events (e.g. social, political, economic and environmental changes)* (Longstaff et al., 2010; Adger, 2000). The resilience of a social system can be achieved when a high access to those factors is provided: *food access, health care access, access to credit, access to public programs, access to markets, access to alternative technologies, and access to education* (McCune et al., 2012). Within this context; the resilience of SEPLS is focused on how a society deals with change and how the capacity of renewal and innovation is provided (Berkes et al., 2003). The resilience of SEPLS requires a management that secures the capacity of ecosystems to sustain societal development and progress with essential ecosystem services (Folke et al., 2003). Major attributes of the aforementioned management are *adaptability*, *flexibility* and *collaborative partnership* in a network-based pattern. This type of management emerges as a response to perception that systems are dynamic and complex, and that management in the face of complexity and uncertainty requires participation of interested parties (Hahn et al., 2006). Within this context; the SEPLS of Lefke Region located in North Cyprus have been selected as case study area.

Scope of the study

The purpose of this study is to assess the resilience of *socio-ecological production landscapes and seascapes* (SEPLS) of Lefke Region in North Cyprus in the face of disturbance factors (e.g. drought, urbanization and land abandonment) by adopting a set of indicators. The research question in this study is *what is the current situation (degree) of the resilience of the SEPLS in Lefke Region*? *Are they becoming more vulnerable, resilient or adapting to changing conditions of the region*? Accordingly, the main objectives of the study include measurement of the respective resilience of the ecological, social and agricultural systems of the SEPLS by using relevant indicators. It is expected that the findings and conclusions of this study can draw attention of policy makers and natural resource managers on building and strengthening the resilience of the SEPLS of Lefke Region in terms of biodiversity conservation, sustainable agricultural production and livelihood development.

2. Material and method

2.1. Study area: Lefke Region

Cyprus Island is located in the Eastern Mediterranean region. The Mediterranean-type climate dominates in the island (Delipetrou et al., 2008). The island is an element of the Mediterranean phytogeographic region, which is internationally recognized as one of the world's floristic hotspots due to its species richness and high ration of endemics (Myers and Giller, 1988; Davis et al., 1994; Meídail and Queízel, 1997). Cyprus Island has diverse landscapes due to varied climate and geology and its proximity to Asia, Africa and Europe. Human presence on the island dates back to 10,000–12,000 years ago when sailor-hunter colonizers first arrived (Delipetrou et al., 2008). The flora of Cyprus is representative of the eastern Mediterranean phytogeographic region with typical features of agro-sylvo-pastoral systems and the dominance of pine species (*Pinus brutia* Ten.) (UNESCO-FAO, 1969; Vural et al., 2010). Accordingly, Lefke Region has been selected as a case study area due to its representative landscape features (Fig. 1).

Lefke Region is located on the north-western part of the Cyprus Island. The region comprises twelve villages. According to the statistical data of the State Planning Organization in 2013; the total population of the Region is 11.091 (KKTC Devlet Planlama Örgütü, 2013). The harmonious relationship between nature and culture has led to formation of productive SEPLS in Lefke Region. Within this study, they are valued as living environment, cultural heritage, source of food production, biodiversity, and ecotourism. These landscapes comprise a mosaic of terrestrial (e.g. pine forest, maquis and agricultural lands), coastal (e.g. beaches) and marine ecosystems (Fig. 2). The maquis vegetation (e.g. laurel, carob, mastic tree) represents rural landscape characteristics of the region. The maquis formation has shrunk due to the impacts of on-going urbaniza-