



Exploring the Function of Home Gardens in Strengthening the Resilience of Social-Ecological Landscapes through Cross-Scale Interactions: A case Study from Lefke City of the Northern Cyprus

Gülay ÇETİNKAYA ÇİFTÇİOĞLU¹

Abstract

The purpose of this study is to evaluate the function of home gardens in strengthening the resilience of the social-ecological landscape system in Lefke City of the Northern Cyprus through a set of cross-scale interactions. In doing so, the objectives of the study were (i) to design a conceptual framework that links the resilience of the home garden and landscape systems through a range of cross-scale interactions, (ii) to identify the major cross-scale resilience assessment indicators at the home garden (site) scale, and (iii) to quantify the resilience of the home garden system and to evaluate its inter-linkages with the resilience of the landscape system. The method of the study consisted of three parts. Firstly, a conceptual framework, which depicts the relationship between the resilience of the home garden and landscape systems through a set of cross-scale interactions, was designed by reviewing the relevant literatures. Secondly, appropriated cross-scale resilience assessment indicators at the home garden scale were identified through an in-depth literature review. Thirdly, the relevant data on the identified indicators were collected by employing a social preference approach and then evaluated by performing the Statistical Package for Social Science (SPSS). A social preference approach was adopted to collect the relevant data. Within this context, a questionnaire form was designed to explore stakeholders' perceptions regarding the objectives of the study. The interviewees expressed their perceptions on a 0-5 Likert Scale. Assessment of the results revealed that plant diversity and spatial connectivity are the key cross-scale principles to link the ecological resilience of the home garden with landscape systems. The social resilience of the both systems is interlinked with five principles (maintenance of food production, income diversification, demographics, cultural heritage, and traditional knowledge). The average relative value of the ecological and social resilience of the home garden system was estimated to be medium with a 3,15 points and low with a 2,16 points respectively. The total average relative value of the resilience of the home garden system was estimated to be low with a 2,41 points. Several drivers (e.g. intensive urbanization and landscape fragmentation) have been identified as the driving forces behind the decline of the resilience of the both systems. Understanding the interconnectedness between the resilience of different spatial units and scales may help policy-makers, planners, and land managers to design a mechanism that integrates the cross-scale interactions into planning and relevant strategies.

KEYWORDS: Social-ecological landscape, home garden, resilience, cross-scale interactions, cross-scale resilience assessment indicators, Northern Cyprus,

¹Architecture Department, Cyprus Science University, Ozanköy/Girne, The Turkish Republic of the Northern Cyprus (TRNC)
*İlgili yazar / Corresponding author: gulayciftcioglu@csu.edu.tr

Gönderim Tarihi / Submission Date: 16.09.2019
Kabul Tarihi / Acceptance Date: 19.12.2019

Bu makaleye atf yapmak için- To cite this article
Çiftçioğlu, G. Ç. (2019). Exploring the Function of Home Gardens in Strengthening the Resilience of Social-Ecological Landscapes through Cross-Scale Interactions: A case Study from Lefke City of the Northern Cyprus. *Resilience*, 3(2), 327-347.

1. INTRODUCTION

Human activities (e.g. global population growth and intensive urbanization) over the past fifty years have altered ecosystems around the world faster and more extensively than at any other time in history (Folke et al., 2016). Such large-scale and rapid changes have caused diverse environmental (e.g. loss of native ecosystems and biodiversity) and social (e.g. population increase and migration) problems (Ostrom, 2007; Sanderson et al., 2002; Tengberg et al., 2012; McNeely, 2010; MA, 2005; Costanza et al., 2014). However, the global society ultimately depends on the world's ecosystems, their life-supporting processes, and services (Gaffikin, 2009). In other words, humans and ecosystems are an inextricably linked system (Fletcher et al., 2014). For that reason, the major challenge is to maintain and enhance the beneficial contributions of nature for all people (Díaz et al., 2018). Within this context, several *global research programmes such as* the Millennium Ecosystem Assessment (MA, 2005) and the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES) were developed (Gaffikin, 2009; Díaz et al., 2018). All these global initiatives draw attention to the significance of the approaches of social-ecological system and resilience to governing landscapes, ecosystems, associated biodiversity, and ecosystem services (Heslinga et al., 2017; Sanderson et al., 2002; Tengberg et al., 2012; Preiser et al., 2018).

Social-ecological systems refer to a linked *system*² of people and nature (Walker and Salt, 2006). Such well-functioning and long-lived systems are composed of biophysical (e.g. resources) and social components (e.g. institutions and knowledge systems) (Janssen et al., 2007). These systems consist of relationships between elements at a number of scales and within nested systems (Du Plessis, 2008). The socio-ecological systems undergo a process known as the '*adaptive cycle*'³ (Cunningham, 2013). More recently, a number of scholars have come to think of landscapes as a social-ecological system (Fischer, 2018). The social-ecological landscapes are a complex 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). These landscapes are a linked system of people (cultural diversity) and nature (biodiversity) (Berkes et al., 2003). People have shaped, maintained, and developed these productive landscapes over centuries (Gallopín, 1991; Turner et al., 2003, Scholz et al., 2011). The complex social-ecological landscape system consists of ecological and social systems (Binder et al., 2013). All components of ecological (e.g. forests, wetlands, medicinal plants, and native vegetation) and social (e.g. population, social organizations, institutions, and networks) systems are functionally linked in complex social-ecological landscapes (Pickett et al., 1997). These landscapes continually develop depending on their exposure to disturbances, their resilience, adaptive cycle, and adaptive capacity in the long-term (Charette-Castonguay, 2014; Sharifi and Yamagata, 2016a). The

²Systems are seen as at least two elements that are interconnected (Scott, 2015). There are various definitions of 'a system'. For example, Hall and Fagen (1956) defined system as 'an entity with certain properties that can be distinguished from its surrounding environment'. According to Mele et al. (2010), a system can be defined as an entity, which is a coherent whole such that a boundary is perceived around it in order to distinguish internal and external elements and to identify inputs and outputs emerging from the entity. A system can be natural (e.g., lake) or built (e.g., government), physical (e.g., space shuttle) or conceptual (e.g., plan), closed (e.g. chemicals in a closed bottle) or open (e.g. tree), static (e.g. bridge) or dynamic (e.g. human) (Mele et al., 2010). Systems, where social, economic, ecological, cultural, political, technological, and other components are strongly linked, are known as social-ecological systems. Such systems emphasize the integrated concept of the 'humans-in-nature' perspective (Petrosillo et al., 2015).

³The *adaptive cycle* is a way of describing the progression of social-ecological systems through various phases of organization and function. Four phases are identified: rapid growth, conservation, release, and reorganization. The manner in which the system behaves is different from one phase to the next with changes in the strength of the system's internal connections, its flexibility, and its resilience (Walker and Salt, 2006). When a system undergoes a major change, causing the system to shift into another phase of the adaptive cycle, it is said to undergo a disturbance (e.g. drought, fire, floods, and migration) (Holling, 2001; Cunningham, 2013).

social-ecological landscapes provide essential ecosystem services (e.g. supply of food, fiber, energy, and drinking water) to society (Berkes and Folke, 1998; Unnasch et al., 2008; Baral et al., 2014). However, some of these long-lived landscapes are experiencing difficulty in continuing to function due to the impacts of several drivers (e.g. land use change) at present (Janssen et al., 2007). Scientists are worried that many of the social-ecological landscapes existing today may collapse by the end of the 21st century (Ostrom, 2007). Therefore, there is a growing interest from researchers and the public to understand the dynamics of the social-ecological landscapes and to support their sustainability (Leenhardt et al., 2015). More recently, 'resilience' has emerged as the most important theory to build and assess the sustainability of the social-ecological landscape system (Sarkki et al., 2017).

The theory 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). Resilience has emerged as a conceptual framework to understand changes and cross-scale interactions in the social-ecological systems (Gunderson and Holling 2002; Berkes et al., 2003; Ciftcioglu, 2017a). The theory of resilience has become a new and growing topic of interest for a variety of disciplines (e.g. ecology, economics, planning, and design professions) (Hassler & Kohler, 2016; Lizarralde et al., 2014, Ciftcioglu 2018) due to the intensive changes in native ecosystems over the past 50 years (MA, 2005). Depending on the disciplines, *three major resilience approaches*⁴ (e.g. engineering resilience) have emerged (Sharifi and Yamagata, 2016a). More recently, landscapes, economies, cities, buildings, and plans are expected to be resilient to unforeseen externalities in a world of rapidly changing technologies, climates, and cultures (Desouza et al., 2012; Schipper & Langston, 2015, Ciftcioglu, 2018). There are various definitions for the term of resilience (e.g. Walker and Salt, 2006; Cunningham, 2013; Ciftcioglu, 2017a). According to Plieninger and Bieling (2012), *resilience refers to the capacity or ability of a system to deal with disturbances or changes without altering its essential characteristics* (Plieninger and Bieling, 2012; Ciftcioglu, 2017a). Or, it can be defined as *the amount of change a system can undergo and still retain the same controls on its function and structure, and the degree to which the system is capable of self-organization, and it is enhanced by the ability of a system to increase its capacity for learning and adaptation* (Adger, 2000; Sarkki et al., 2017). In other words, *resilience refers to the conditional probability that a system in one stability domain will flip into another stability domain given its current state and the disturbance regime* (Perrings, 2006). Resilience does not necessarily mean that the system will look just as it did before a disturbance. It will maintain its functions, but the individual parts of the system may have changed (adapted) to new conditions in the environment (Longstaff et al., 2010). The resilience of a system comprises three characteristics: (i) the capacity to absorb shocks and maintain functions, (ii) to self-organize and, (iii) to learn and adapt (Carpenter and Brock, 2008; Mijatović et al., 2013). Resilience is an attribute, property, and/or the core of a social-ecological system (Walker et al., 2004; Folke et al., 2010, Heslinga et al., 2017). The theory of resilience has emerged as a conceptual framework, which contributes to the better understanding of changes and cross-scale interactions in the social-ecological systems and to determining such systems to adapt to change and to share the relevant interest in the protection, management, and planning of areas (Plummer and Armitage, 2007, Heslinga et al., 2017; Ruhl and Stuart Chapin, 2013). The resilience of social-ecological systems such as landscapes depends on a variety of variables (e.g. biodiversity) at different scales (Berkes et

⁴The major resilience approaches comprise: engineering, ecological, and social-ecological resilience. *The engineering resilience* conceptualizes resilience of a system as its physical resistance and its capacity to rapidly return to an equilibrium state in case the thresholds are exceeded. *The ecological resilience* focuses on that shocks are not always predictable. It advocates enhancing the tolerance of a system and recognizes that the system may need to shift to new equilibrium state(s) in order to be able to retain its pre-disaster functionality. *The social-ecological resilience* is based on the conceptualization of a system as a dynamic socio-ecological entity that continuously undergoes transformation (Sharifi and Yamagata, 2016a).

al., 2000 and 2003; Mijatović et al., 2013). Thus, resilience of the different spatial units (e.g. home garden and landscape) influences each other through multiple cross-scale interactions.

Cross-scale interactions refer to processes at one spatial or temporal scale interacting with processes at another scale that often result in nonlinear dynamics within thresholds. Cross-scale interactions are important to understand the relationships between fine-scale and broad-scale patterns, processes, and drivers to result in ecosystem change (Peters et al., 2007). The social-ecological landscapes consist of different spatial units (e.g. home gardens and ecosystems). Home gardens are one of the smallest patches and integrated systems in the social-ecological landscapes (Agbogidi and Adolor, 2013). They are located in proximity of human dwellings and often delimited from their surroundings by hedges, fences, and other barriers (Agbogidi and Adolor, 2013; Polegri and Negri, 2010). They produce a variety of goods (e.g. vegetables, fruits, and ornamental plants) and services (e.g. climate regulation and aesthetic quality) for human wellbeing. They are also important sites for *in situ* conservation of a wide range of plant genetic resources (Agbogidi and Adolor, 2013). Biodiversity is an important property of home gardens that contributes to strengthening the resilience of home gardens at the site scale and the resilience of social-ecological landscapes through a set of cross-scale interactions (Mijatović et al., 2013; McPhearson et al., 2014; Dewaelheyns et al., 2011; Farinha-Marques et al., 2017; Suárez et al., 2016; Sarkki et al., 2017; Smith et al., 2006; Carabine et al., 2015; Norris, 2012; Maruyama, 2016). Thus, the social-ecological landscapes, home gardens, and associated biodiversity are functionally linked through a number of cross-scale interactions. For that reason, the theory of resilience, which is a system-based approach, should be adapted to better understand and assess the dynamic relationship between the home garden and landscape systems, and the cross-scale interactions between the both systems' components. Accordingly, the purpose of this study is to evaluate the function of home gardens in strengthening the resilience of the social-ecological landscape system in Lefke City of the Northern Cyprus through a set of cross-scale interactions. In doing so, the objectives of the study were (i) to design a conceptual framework that links the resilience of the home garden and landscape systems through a range of cross-scale interactions, (ii) to identify the major cross-scale resilience assessment indicators at the home garden (site) scale, and (iii) to quantify the resilience of the home garden system and to evaluate its inter-linkages with the resilience of the landscape system. It is expected that the results of this study can help policy makers, planners, and land managers to better understand the linkages between the resilience of different spatial units and scales, and to design a mechanism that integrates the cross-scale interactions into planning and relevant strategies.

2. MATERYAL AND METHOD

2.1. Study area: Lefke City in the Northern Cyprus

Cyprus is the third largest island in the Mediterranean Basin with a typical Mediterranean climate with hot, dry summers, and mild winters (Ciftcioglu, 2015) (**Fig. 1**). The island is one of the 'biodiversity hotspots' in the Mediterranean Region (Myers et al. 2000; Hadjisterkotis, 2001; Hadjikyriakou and Hadjisterkotis, 2002; Ciftcioglu, 2015 and 2018). The Island of Cyprus comprises diverse landscape types due to varied climate and geology, and its proximity to Asian, African, and Europe continents (Delipetrou et al., 2008, Ciftcioglu, 2017a, b and c). 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; Ciftcioglu, 2017a, b, c). Lefke City has been selected as a case study area due to its typical Mediterranean landscape characteristics, vernacular architecture with home gardens, historical, and archaeological heritage values (e.g. the Soil and Vuni Palace archaeological sites).



Fig. 1. The location of Cyprus Island in the Mediterranean Basin (Tomaselli, 1977).

Lefke City is located on the north-western part of the island with its twelve villages. The total population of the region is about 11,091 (5952 males and 5139 females) (Ciftcioglu, 2018, cited in KKTC Devlet Planlama Örgütü, 2013). The positive relationship between the nature and humans has caused the formation social-ecological landscapes in the region. These landscapes comprise a mosaic of ecosystems (e.g. marine, coast, pine forest, Mediterranean maquis formation, agriculture, and home gardens). The diversity of ecosystems has provided a variety of ecosystem services (e.g. food, climate control and cultural heritage) for local people. For example, the study of Ciftcioglu (2018) revealed that the local people collect 49 wild plant, 5 mushroom, and 30 fish species from the terrestrial and marine ecosystems for various purposes (e.g. food, income generation, and nature experience). The home gardens have been one of the smallest patches of the landscapes in the region. The local people spend a significant portion of their daily life in the home gardens, which usually comprise a front and a back yard. The front yard has an open view where ornamental plants with high aesthetic features are dominated. The backyard is used to grow some kinds of vegetables and fruits to provide easy access to raw materials and to support food production (Ciftcioglu, 2017b). The home gardens deliver a variety of ecosystem services (e.g. food, ornamental plants, habitat for pets, aesthetic quality, and sense of place) for the residents. Evidence of Ciftcioglu et al. (2019) showed that the home gardens host 233 ornamental plant species, 61 species of fruits and vegetables, which are cultivated for a variety of purposes (e.g. beautification and food production). The scholars emphasized that the home gardens contribute to a number of components of human wellbeing such as 'secure access to home-grown resources on doorsteps', 'contact with nature', 'development of good social relations', and 'basic materials for a good life'. Unfortunately, the social-ecological landscapes and associated home gardens in Lefke City have degraded and/or lost due to the impacts of several drivers of change (e.g. increasing urbanization trend, land use change, land abandonment, and less maintenance). This situation has caused various irreversible results such as decline in the flow of ecosystem services at the landscape and site scale, landscape and habitat fragmentation, reduction of aesthetic quality, and 'sense of place' (Ciftcioglu, 2015 and 2018).

2.2. Method of the study

The method of the study consisted of three parts. Firstly, a conceptual framework, which depicts the relationship between the resilience of the home garden and landscape systems through a set of cross-scale interactions, was designed by reviewing the relevant literatures. Secondly, appropriated cross-scale resilience assessment indicators at the home garden scale were identified through an in-depth literature review. Thirdly, the relevant data on the

identified indicators were collected by employing a social preference approach and then evaluated by performing the Statistical Package for Social Science (SPSS).

2.2.1. Design of a conceptual framework for linking the resilience of the home garden and social-ecological landscape systems through a set of cross-scale interactions in Lefke City of the Northern Cyprus

Resilience has been a challenging approach to better understanding the dynamics of social-ecological landscape systems and their cross-scale interactions with different sub-systems and to design mechanisms to cope with and to adapt to disturbances (Folke, 2006; Walker et al., 2002; Evans and Caylor, 2009; Walker and Salt, 2006; Ahern, 2011). More recently, several studies highlighted the importance of cross-scale interactions in building and analysing the resilience of systems (Evans and Caylor, 2009; Folke, 2006; Walker et al., 2002). Within this context, a conceptual framework was designed to link the resilience of the home garden system with the landscape system through a number of cross-scale interactions in Lefke City of the Northern Cyprus (**Table 1**).

Table 1. The conceptual framework that links the cross-scale interactions between the social-ecological landscape and home garden systems and their resilience in Lefke City of the Northern Cyprus




Type of system	Spatial scale	Type of spatial property	Resilience-strengthening measure	Resilience-related outcome
Social-ecological landscape	Landscape scale 	Landscape 	Landscape conservation, restoration and management -Conservation of ecosystems - Conservation and management of agro-ecosystems -Restoration of degraded landscapes -Management of water and soil resources -Establishment of new landscapes	-Social-ecological resilience -Ecosystem and natural resources resilience -Community resilience
Home garden	Site scale	Home garden 	Conservation and management of habitats -Conservation of habitats -Habitat quality -Diversification of plant species -Rainwater harvesting -Improvement of soil fertility	-Ecosystem and natural resources resilience -Community resilience

Table 1 shows that the social-ecological landscape system in Lefke City consists of different sub-spatial units (e.g. home gardens) and systems. The landscape and home garden systems have different scales, components, properties of resilience, and measures for enhancing resilience. Both systems are linked in a nested system. In addition, all their aspects are interconnected through a number of cross-scale interactions. Their interconnections are discussed at the base of landscape and site scale below.

The landscape scale: Landscapes comprise a diverse combination of ecosystems at intermediate scales that affect each other across space and time within hierarchies of interdependent ecological processes (Nassauer, 1995 and 1997; Wiens, 1999; Fischer, 2018). Many of the social and ecological processes that affect ecosystems occur at the landscape scale. For that reason, the landscape scale is one of the most suitable spatial units for managing ecosystems (Fischer, 2018). The social-ecological landscapes in Lefke

City comprise a number of ecosystems (e.g. agriculture, pine forest, coast, marine, and settlements). However, several factors (e.g. intensive urbanization, mining operation, and drought) have caused the degradation of relevant ecosystems. Today, the social ecological landscape system is poorly managed in the region. A national landscape planning strategy and relevant management tools are urgently needed to halt the degradation of the ecosystems, to conserve the native ecosystems, to manage the agro-ecosystems, to restore the degraded lands, to conserve and manage the soil and water resources, and to establish new landscapes (e.g. parks and other types of open green spaces) in Lefke City. The landscape scale should comprise a holistic approach that covers all aspects of the landscape system (e.g. ecological, economic, and socio-cultural) and relevant components (e.g. biotic and human). Home gardens are one of the important patches of the landscapes in the region.

The home garden (site) scale: The home gardens have been an important habitat for wild and ornamental plants, pets, and local people in Lefke City. The floristic composition in the home garden context can contribute to the biodiversity and habitat conservation efforts at the site scale. In other words, protection of the home gardens can be a crucial resilient-strengthening measure in terms of habitat conservation and habitat quality. Habitat quality is an important indicator of ecosystem health and can be linked to community economic and societal wellbeing. Moreover, resilient habitats are critical to wildlife and water conservation, and flood control (e.g. forestry, recreation, and tourism) (Homeland Security, 2016). The other resilient-enhancing measures at the site scale may comprise diversification of plant species, rainwater harvesting, and improvement of soil fertility by mulching.

Assessment of the scales and their interconnections shows that the landscape and home garden systems are linked through a number of cross-scale interactions in Lefke City. Thus, a change on a scale directly causes a change in the other scale. For example, the study of Sharifi and Yamagata (2016a) showed that the social-ecological landscapes are facing the growing challenges posed by a broad array of stressors (e.g. population increase, intensive urbanization, and resource depletion). Such large-scale disturbances may not only cause changes at the landscape scale, but also bring changes to the local scale. Accordingly, a number of cross-scale resilience assessment indicators can be used as a strategic tool to understand the linkages between the both systems.

2.2.2. Identification of the major cross-scale resilience assessment indicators at the home garden scale

The social-ecological landscape system comprises several sub-systems (e.g. home gardens). All sub-systems are interrelated through a number of cross-scale interactions, which are the key factors that build a strong relationship between different systems, their components, and their resilience. Within this context, resilience assessment indicators should reflect the cross-scale interactions between different systems. Indicators are qualitative and quantitative variables, which are used to measure the status of a given principle and/or a programme success (Sharifi and Yamagata, 2016a; Schipper & Langston, 2015, Ciftcioglu and Sunalp, 2019). Resilience assessment indicators should be feasible, informative and cost-effective, and should be developed with the aim of creating healthy, attractive, and functional living environments (Kallaos et al., 2014; Ciftcioglu and Sunalp, 2019). The potential cross-scale resilience assessment indicators should reflect the key characteristics of a system's resilience (e.g. robustness, flexibility, resourcefulness, redundancy, and diversity) (Sharifi and Yamagata, 2016b). The appropriate cross-scale resilience assessment indicators at the home garden scale for Lefke City were identified through reviewing the relevant literatures (**Table 2**).

Table 2. The appropriate cross-scale resilience assessment indicators at the home garden scale in Lefke City of the Northern Cyprus

Type of system	Type of resilience	Characteristic of resilience	Principle	Description	Indicator	Example references
Ecological system	Ecological resilience (Conservation and maintenance of ecosystems, habitats, and natural resources)	Resource robustness (Resistance and absorption capacity)	Conservation and maintenance of plant diversity	It means diversity of plant species, which provides materials for recovering and absorbing changes and disturbances.	Degree of decline in plant diversity	Kotschy et al. (2015), Walker (1992), Sharifi and Yamagata (2016a and b), Mijatović et al. (2013), Ciftcioglu and Sunalp (2019)
		Adaptive capacity (Recover and response capacity)	Maintenance of connectivity	It refers to connectivity among green areas and interaction of resources across landscapes that contribute to the flow of energy and materials.	Degree of spatial connectivity of home gardens by nearby green areas	Dakos et al. (2015), Ciftcioglu and Sunalp (2019), Biggs et al. (2012), Carabine et al. (2015), Bodin and Prell (2011), Nyström and Folke (2001).
Social system	Social resilience (Community and individual resilience)	Response capacity	Maintenance of food production	It means the amount of food production that contributes to sustaining the lives of households.	Degree of food production for their own needs in home gardens	UNU-IAS (2013), Ciftcioglu (2017a), Ciftcioglu and Sunalp (2019)
		Recover (adaptive) capacity	Income diversification	It means diversification of incomes and employments that build adaptive capacity and allow individuals and communities to prepare for, respond to, and recover from disasters and risks (Homeland Security, 2016).	Degree of income generated from marketing of home-grown plants	Ciftcioglu (2017a), Ciftcioglu and Sunalp (2019), Homeland Security (2016).
			Demographics	It is about younger generation's interest in plant growth and home garden practices.	Degree of interest of younger generation in plant growth in home gardens	Ciftcioglu (2017a), Ciftcioglu and Sunalp (2019)

				It means the maintenance of cultural diversity (e.g. knowledge) into the future to increase the capacity of human system to adapt to and to cope with change (Homeland Security, 2016).	Degree of use of local plant seeds and species	UNU-IAS (2013), Ciftcioglu (2017a), Homeland Security (2016), Adger (2000).
			Cultural heritage		Degree of growing plants with religious and/or spiritual values in home gardens.	
				Traditional knowledge is a cumulative body of knowledge, practice, and belief, evolving by adaptive processes and handed down through generations by cultural transmission (Berkes, 1999).	Degree of use of local names of plants cultivated in home gardens.	UNU-IAS (2013), Ciftcioglu (2017a), Adger (2000), Berkes (1999).
			Traditional knowledge			

Table 2 shows that the resilience of the home garden system in Lefke City comprises two types of systems (ecological and social system) and their resilience. The cross-scale resilience assessment principles and indicators reflect all relevant aspects.

The resilience of an ecological system means the capacity of an ecosystem to maintain a steady ecological state (Adger, 2000). The ecological resilience strengthens the buffering capacity of a system to absorb perturbations (Holling et al., 1995; Adger, 2000). Biodiversity is the natural insurance of the ecological resilience (Folke et al., 2010; Ciftcioglu, 2017a) and enhances resilience, stability, and ecosystem functioning (Adger, 2000). The ecological resilience of an ecosystem comprises two properties: resource robustness and adaptive capacity. Resource robustness reflects resistance and absorption capacity of resources (e.g. plants) (Longstaff et al., 2010). The key principle for measuring resource robustness is diversity (e.g. diversity of plants) (Ciftcioglu and Sunalp, 2019; Longstaff et al., 2010). Diversity means the number of different kinds of elements (e.g. plant species and landscape patches) that make up a system (Kotschy et al. 2015; Kotschy, 2013). Diversity is a key tenet of resilience thinking and supports resilience in a range of different ways. Different organisms perform different functions in an ecosystem that help balance the vital elements of the system in a way that prevents the depletion of key ecological resources (Carabine et al., 2015; Maruyama 2016). In respect to resilience, two types of diversity are particularly important. The first one is functional diversity, which refers to the range of functional groups (e.g. groups of different kinds of species like trees, grasses, deer, wolves, and soil) that a system depends on. Functional diversity underpins the performance of a system. The second is response diversity, which is the range of different response types existing within a functional group. Resilience is enhanced by increased response diversity within a functional group (Walker and Salt, 2006; Walker, 1992 and 1995; Chelleri, 2012; Leslie and McCabe,

2013). In addition, Kotschy et al. (2015) highlighted that systems with many different components are generally more resilient than systems with few components or less heterogeneous components. Thus, diversity is a key cross-scale principle that contributes to enhancing the ecological resilience of the home garden and landscape systems, and the inter-linkages between them. Adaptive capacity is also an important aspect of ecological resilience. It means the recover or response capacity of an ecological system and its resources to disturbances (e.g. climate change and floods) (Whitney et al., 2017). Connectivity is a key principle to measure the adaptive capacity of an ecological system (Ciftcioglu and Sunalp, 2019; Longstaff et al., 2010). Connectivity is defined as the manner by which and extent to which resources and species migrate, or interact across ecological system (Biggs et al., 2012; Carabine et al., 2015; Dakos et al., 2015; Bodin and Prell, 2011). Connectivity facilitates the flow of energy, material or information necessary for the resilience of ecosystem services at the landscape scale (Nyström and Folke, 2001; Dakos et al., 2015; Carabine et al., 2015). Connectivity can enhance the resilience of landscapes and home gardens by acting as a barrier against disturbances and can facilitate the maintenance of biodiversity at the landscape scale, which underlines the production of many ecosystem services (Dakos et al., 2015). Thus, plant diversity and connectivity are the key cross-scale resilience principles that can help us to measure the ecological resilience of the home gardens and to explore its linkage with the social-ecological landscape system in Lefke City. However, the ecological resilience is strongly linked with the social resilience, as communities are heavily dependent on the ecological resources for their livelihoods (Adger, 2000).

The social resilience means the ability of groups or communities to cope with external stresses and disturbances as a result of social, ecological, political, and environmental change (e.g. floods and economic shocks) (Adger, 2000). The social resilience is about the response and recover capacity of individuals and communities. The response capacity of a social system means to respond quickly to save lives, protect property and the environment, and to meet basic human needs in the aftermath of an incident (Homeland Security, 2016). Within this context, 'maintenance of food production' can be used as a key principle to measure the degree of the social resilience. The recover (adaptive) capacity of a social system means to assist communities affected by an incident to recover through a focus on the timely restoration, strengthening, and revitalization of infrastructure, housing, and the economy, as well as the health, social, cultural, historic, and environmental fabric of communities (Homeland Security, 2016; Ciftcioglu and Sunalp, 2019; Kallaos et al., 2014; Walker & Salt, 2006). The key principles for measuring the adaptive capacity of a social system comprise connectivity and traditional knowledge (Ciftcioglu and Sunalp, 2019; Longstaff et al., 2010). Connectivity can be defined as the manner by which social actors move across landscapes and interact with different groups and/or stakeholders (Biggs et al., 2012; Carabine et al., 2015; Dakos et al., 2015; Bodin and Prell, 2011). Connectivity facilitates the flow of information necessary for the social resilience at the landscape scale (Nyström and Folke, 2001; Dakos et al., 2015). Traditional knowledge means the cumulative knowledge and practices of people (Berkes, 1999), which should be integrated with scientific knowledge to design co-adaptive management strategies for the social-ecological landscapes and good governance of natural resources. Accordingly, five cross-scale principles and relevant indicators were proposed to measure the social resilience of the home garden system and to evaluate its linkage with the social-ecological landscape system in Lefke City.

2.2.3. Data collection and analysis

The dataset of the research titled "*Exploring the resilience of social-ecological landscapes by linking ecosystem services, human wellbeing, and adaptive comanagement: Situation*

analysis for Lefke City of the Northern Cyprus” (Ciftcioglu, 2017a, b and c; Ciftcioglu, 2018) was used in this paper. This section of the study consisted of two parts: data collection and data analysis.

Data collection: A questionnaire form was designed to collect the data on “homeowners’ perceptions regarding the importance of the home gardens in strengthening the cross-scale social-ecological landscape resilience”. The perceptions of the interviewers were examined by a number of relevant indicators, which were identified in the previous section. The indicators were given as a question in the questionnaire. The questionnaire was pretested with several interviewers and then revised. The questionnaire form had two parts. The first part focused on the profile of interviewers (e.g. age, gender, and occupation). The perceptions of the interviewers were questioned in the second part. Within this context, the interviewers were asked eight questions. They expressed their values on a 0-5 Likert scale, where: 0 shows no relevant importance, 3 shows medium relevant importance, and 5 shows very high relevant importance. The interviewers were sampled by applying a purposive and snowball sampling method. The criterion for sampling interviewers was “to have a home garden”. Accordingly, we interviewed with a total number of 106 local community members from 12 villages located in Lefke City (**Table 3**). The questionnaire was applied face-to-face in the home gardens of the interviewers. They were informed about the aim, objectives, and expected outcomes of the study during the meetings. The relevant data were collected between December 2015 and April 2016.

Table 3. Population profile of the interviewers in this study (Ciftcioglu, 2017a, b and c; Ciftcioglu, 2018).

Population profile	Category of population profile	Number of interviewers	Percentage of interviewers
Gender	Female	29	27,4
	Male	77	72,6
Education level	Primary school	29	27,4
	High school	43	40,6
	College	34	32,1
Occupation	Farmer	8	7,5
	Office clerk	22	20,8
	Fisherman	2	1,9
	Student	1	0,9
	Retired	21	19,8
	Self-employed	31	29,2
	Housewife	21	19,8
Age range	Under 19	1	0,9
	Between 20-29	9	8,5
	Between 30-39	23	21,7
	Between 40-49	15	14,2
	Between 50-59	31	29,2
	60- over 60	27	25,2

Table 3 indicates that most of the interviewers are either with a high school (40,6%) or college (32,1%) degree. Most of the people are self-employed (29,2%), office clerk (20,8%), or retired and housewife (19,8%). Their age profile changes between 50-59 (29,2%) and 60-over 60 (25,2%). The younger generation migrated to the urban cities (Nicosia or Kyrenia) for employment opportunities; therefore, their participations in the study were very limited.

Data analysis: The collected data by the questionnaire were evaluated using the Statistical Package for Social Science (SPSS version 15.0, SPSS). The average relative value of each indicator was estimated by dividing the total score to the total number of the interviewers.

3. Results and discussion: Evaluation of the role of home gardens in strengthening the social-ecological landscape resilience through the cross-scale interactions in Lefke City of the Northern Cyprus

This part of the study represents the perceptions of stakeholders regarding the importance of home gardens in enhancing the resilience of the social-ecological landscape in Lefke City of the Northern Cyprus. The resilience of the home gardens was measured with a number of cross-scale resilience assessment indicators on the 0-5 Likert Scale. Assessment of the relevant data is given in **Table 4**.

Table 4. Descriptive statics regarding the function of the home gardens in strengthening the resilience of the social-ecological landscape system through the cross-scale interactions in Lefke City of the Northern Cyprus (on the 0-5 Likert Scale) (n: 106).

Type of system	Type of resilience	Characteristic of resilience	Principle	Indicator	Mean value	Std. Deviation	Current state
Ecological system	Ecological resilience	Resource robustness	Conservation and maintenance of plant diversity	Degree of decline in plant diversity	3,83	1,26	Medium plant diversity
		Adaptive capacity	Maintenance of connectivity	Degree of spatial connectivity of home gardens by nearby green areas	2,48	1,36	Low connectivity
The average relative value of the ecological resilience of the home garden system					3,15	1,31	Medium
Social system	Social resilience	Response capacity	Maintenance of food production	Degree of food production for their own needs in home gardens	2,15	1,20	Low food production
		Recover (adaptive) capacity	Income diversification	Degree of income generated from marketing of home-grown plants	1,11	0,55	Very low
			Demographics	Degree of interest of younger generation in plant growth in home gardens	1,97	1,28	Very low
			Cultural heritage	Degree of use of local plant seeds and species	1,94	1,23	Very low
				Degree of growing plants with religious and/or spiritual values in home gardens.	1,65	1,19	Very low

			Traditional knowledge	Degree of use of local names of plants cultivated in home gardens	4,17	0,96	High
The average relative value of the social resilience provided by the home garden system					2,16	1,06	Low
The total average relative value of the resilience of the home garden system					2,41	1,12	Low

Table 4 shows that the resilience of the home garden system consists of two types of resilience: the ecological and social (including a limited economic resilience) (**Fig. 2**).

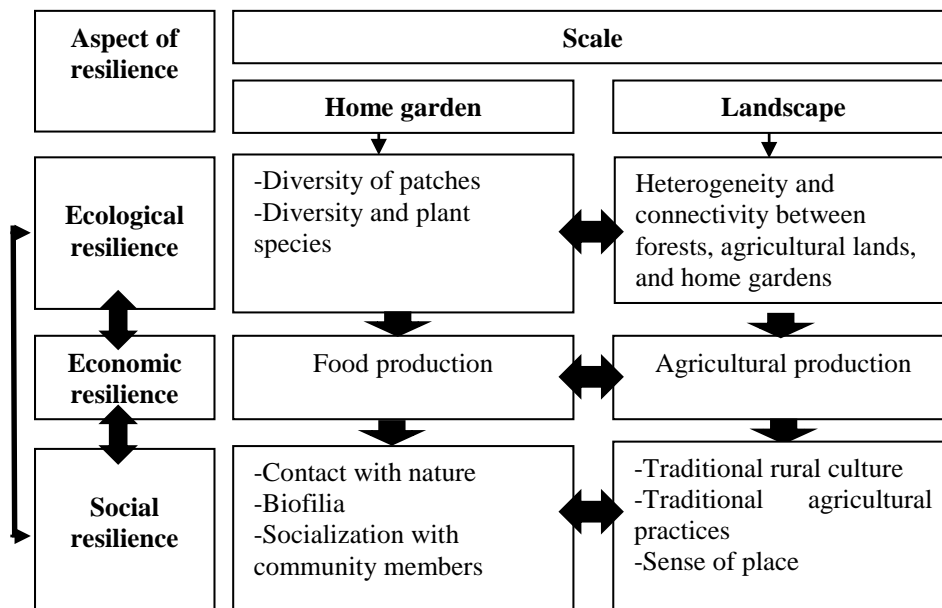


Fig. 2. The cross-scale interactions between the resilience of landscape and home garden systems in Lefke City

The ecological resilience of the home garden system and its linkage with the social-ecological landscape system were evaluated with two indicators. Plant diversity is a key indicator at the home garden scale. It directly influences the landscape resilience through a number of cross-scale interactions. Plant diversity enhances the resistance and absorption capacity of the ecological system at the home garden scale. In other words, abundance of different plant species increases the functional and response diversity of the home garden system to disturbances (e.g. drought). The degree of decline in plant diversity of the home gardens in Lefke City was estimated to be medium with a 3,83 points. The interviews with the participants and field observations revealed that the current trend in plant diversity at the home garden scale is in a decline process due to the impacts of several factors (intensive urbanization, degradation and loss of home gardens, ageing of the society, less interest of the younger generation in home garden practices, and less maintenance). The decline in plant diversity at the site scale may lead to the degradation of biodiversity and heterogeneity of the landscapes through the cross-scale interactions. In addition, the loss and/or degradation of the home gardens may cause a decline in the degree of spatial connectivity at the site and landscape scale in the region. The degree of spatial connectivity of the home gardens by nearby green areas was determined to be low with a 2,48 points. The degree of connectivity at the site scale can adversely influence the ecological resilience of the landscape system (e.g. decline in the buffering capacity of the landscape system against disturbances), the maintenance of biodiversity, and the flow of ecosystem services at the

landscape scale. The average relative value of the ecological resilience of the home garden system was estimated to be medium with a 3,15 points in Lefke City. However, the ecological resilience is directly linked with the social resilience.

The social resilience of the home garden system was evaluated by five principles and relevant indicators. Assessment of the collected data and field observations revealed that the local people cultivate various plant species in the home gardens to meet their own needs. However, the degree of food production in the home gardens was calculated to be low with a 2,15 points. The local people generate a very low income (with a 1,11 points) from marketing the home-grown plant species. This situation shows that the local people have engaged in food production to meet their basic needs. Both indicators reflect the importance of the home gardens in strengthening the economic resilience of the local people. The degree of younger generation in plant growth in the home gardens was estimated to be very low with a 1,97 points. The younger population have lost their interest in the home gardens and agriculture practices due to the impacts of migration to urban cities for employment reason and modernization. The principle of cultural heritage was evaluated by two indicators, which were estimated to be very low. However, traditional knowledge regarding the 'use of the local names of plant species cultivated in the home gardens' was estimated to be high with a 4,17 points. This situation shows that the relevant traditional knowledge is still in use in the region. The principles of 'demographics' and 'traditional knowledge' are mutually related. For example, migration of the younger generation from the region may lead to a halt in the transmission of relevant traditional knowledge. The other driving forces for degrading the social resilience at the site scale were identified as 'intensive urbanization' and 'ageing of the society'. All these factors together cause the degradation and/loss of the home gardens at the site scale, which result in the degradation of the ecological resilience of the landscapes, individual and community-based resilience at the both scales. Within this context, the average relative value of the social resilience at the home garden scale was tended to be low with a 2,16 points. The total average relative value of the resilience of the home garden system was estimated to be low with a 2,41 points. Degradation of the ecological and social resilience of the home gardens (e.g. decline in plant diversity and connectivity) at the site scale can cause a decline in the biodiversity, heterogeneity, food production, traditional land uses, and the social-ecological landscape through the cross-scale dynamic interactions. All of them together can lead to a decline in the resilience of the communities in Lefke City. In other words, the ecological and community (social and economic) resilience are interlinked.

4. CONCLUSIONS

The home gardens are one of the smallest spatial units of the social-ecological landscapes in Lefke City. In other words, the home gardens are a small social-ecological system, which is located in the larger social-ecological landscape system in the region. Both systems are interconnected through several cross-scale interactions (e.g. spatial connectivity). The home gardens perform as a habitat, which increases the resilience of the landscapes and the flow of ecosystem services through enhancing the species diversity, spatial heterogeneity, and connectivity. For that reason, the home gardens should be preserved to contribute to the biodiversity conservation and the sustainable flow of ecosystem services at the landscape scale in Lefke City. In addition, the cross-scale interactions between the home garden and landscape systems should be integrated within the relevant planning strategies not only in Lefke City but also elsewhere of the Northern Cyprus. Thus, the home gardens should be used as a management tool to rapidly estimate the resilience of social-ecological landscapes in Lefke City and elsewhere.

Evaluation of the linkages between different spatial units helped us to identify the key cross-scale resilience assessment principles and indicators. Such ecological (e.g. spatial

heterogeneity and connectivity) and social principles (e.g. traditional ecological knowledge and cultural heritage) and relevant indicators are important management tools, which should be integrated into the relevant conservation and management strategies.

On the other hand, managing for resilience of the complex social-ecological landscapes requires one of the adaptive management approaches. Within this context, adaptive comanagement is a strong and effective landscape management approach that helps to build and strengthen the resilience of the complex landscape systems. Adaptive comanagement is a flexible and community-based management approach. The management responsibilities are shared between the governmental and public stakeholders. As a result, adaptive comanagement can contribute to building and enhancing the resilience of the home gardens, the social-ecological landscapes, and associated ecosystem services in Lefke City and elsewhere.

REFERENCES

- Adger., W.N. (2000). Social and ecological resilience: are they related. *Progress in Human Geography*, 24(3), 347–364.
- Agbogidi, O.M. and Adolor, E.B. (2013). Home gardens in the maintenance of biological diversity. *Applied Science Reports*, 1(1), 19-25.
- Ahern, J. (2011). From fail-safe to safe-to-fail: Sustainability and resilience in the new urban world. *Landscape and Urban Planning*, 100, 341-343.
- Baral, H., Keenan, R.J., Stork, N.E., Kasel, S. (2014). Measuring and managing ecosystem goods and services in changing landscapes: a south-east Australian perspective. *Journal of Environmental Planning and Management*, 57(7), 961-983.
- Berkes, F. (1999). *Sacred ecology: Traditional ecological knowledge and resource management*. Philadelphia and London: Taylor and Francis.
- Berkes, F. and Folke, C. (1998). *Linking social and ecological systems: management practices and social mechanisms for building resilience*. Cambridge, UK: Cambridge University Press.
- Berkes, F., Colding, J., Folke, C. (2000). Rediscovery of traditional ecological knowledge as adaptive management. *Ecological applications*, 10(5), 1251–1262.
- Berkes, F., Colding, J., Folke, C. (Eds.). (2003). *Navigating social–ecological systems: Building resilience for complexity and change*. Cambridge: Cambridge University Press.
- Biggs, R., Schlüter, M., Biggs, D., Bohensky, E.L., BurnSilver, S., Cundill, G., Dakos, V., Daw, T.M., Evans, L.S., Kotschy, K., Leitch, A.M., Meek, C., Quinlan, A., Raudsepp-Hearne, C., Robards, M.D., Schoon, M.L., Schultz, L., West, P.C. (2012). Toward principles for enhancing the resilience of ecosystem services. *Annual Review of Environment Resources*, 37(3), 3.1-3.28.
- Binder, C.R., Hinkel, J., Bots, P.W.G., Pahl-Wostl, C. (2013). Comparison of framework for analyzing socio-ecological systems. *Ecology and Society*, 18(4), 26.
- Bodin, Ö. and Prell, C. (Eds.). (2011). *Social networks and natural resource management: uncovering the social fabric of environmental governance*. Cambridge: Cambridge University Press.
- Carabine E, Venton C.C, Tanner T, Bahadur A. (2015). The contribution of ecosystem services to human resilience. Shaping policy for development. February 2015. Erişim adresi:

(26 Eylül 2017): <https://www.odi.org/sites/odi.org.uk/files/odi-assets/publications-opinion-files/9394.pdf>

Carpenter, S.R., and Brock, W.A. (2008). Adaptive capacity and traps. *Ecology and society*, 13(2), 40.

Charette-Castonguay, A. (2014). *Assessment of resilience and adaptability of social-ecological systems: a case study of Banaue rice terraces*. Master Thesis. Christian-Albrechts Universität zu Kiel.

Chelleri, L. (2012). From the “Resilient City” to urban resilience. A review essay on understanding and integrating the resilience perspective for urban system. *Documents d’Analisi Geografica*, vol. 58/2, 287-306.

Ciftcioglu, G.C. (2015). Sustainable wild-collection of medicinal and edible plants in Lefke Region of North Cyprus. *Journal of Agroforestry Systems (AGFO)*, 89(5), 917–931.

Ciftcioglu, G.C. (2017a). Assessment of the resilience of social–ecological landscapes and seascapes: A case study from Lefke Region of North Cyprus. *Journal of Ecological Indicators*, 73, 128–138.

Ciftcioglu, G.C. (2017b). Social preference-based valuation of the links between home gardens, ecosystem services, and human wellbeing in Lefke Region of Northern Cyprus. *Ecosystem Services*, 25, 227-236.

Ciftcioglu, G.C. (2017c). Assessment of the relationship between ecosystem services and human wellbeing in the social-ecological landscapes of Lefke Region in North Cyprus. *Landscape Ecology*, 32(4), 897-913.

Ciftcioglu, G.C. (2018). Revealing major terrestrial- and marine species-based provisioning ecosystem services provided by the socio-ecological production landscapes and seascapes of Lefke Region in North Cyprus. *Journal of Environment, Development and Sustainability*, (20)1, 197-221.

Ciftcioglu, G.C. and Sunalp, C. (2019). Exploring the linkages between the building, home garden and human system resilience in Lefke Region of North Cyprus. *Landscape Research*, 44(6), 716-730.

Ciftcioglu, G.C., Ebedi, S., Abak, K. (2019). Evaluation of the relationship between ornamental plants-based ecosystem services and human wellbeing: A case study from Lefke Region of North Cyprus. *Ecological Indicators*, 102, 278-288.

Costanza, R., de Groot, R., Sutton, P., van der Ploeg, S., Anderson, S. J., Kubiszewski, I., & Turner, R.K. (2014). Changes in the global value of ecosystem services. *Global Environmental Change*, 26, 152-158.

Cunningham K.L. (2013). *Resilience theory/A framework for engaging urban design*. Master Thesis of Landscape Architecture, Kansas State University. US.

Dakos, V., Quinlan, A., Baggio, J.A., Bennett, E., Bodin, Ö., Burn Silver, S. (2015). *Principle 2 – Manage connectivity*. Biggs R, Schlüter M, Schoon M.L (Eds), In: Principles for building resilience, sustaining ecosystem services in social-ecological systems (80-104). Cambridge: Cambridge University Press.

Delipetrou, P., Makhzoumi, J., Dimopoulos, P., Georghiou, K. (2008). *Cyprus*. Vogiatzakis, I., Pungetti, G., Mannion, A.M. (Eds.), *Mediterranean Island Landscapes, Natural and Cultural Approaches* (170-219). Berlin: Springer.

Desouza, K. C., Flanery, T., Alex, J., & Park, E. (2012). *Getting serious about resilience in planning*. Planetizen. Erişim adresi (15 Mayıs 2019): <http://www.planetizen.com/node/57827>

Dewaelheyns V, Bomans K, Gulinck H (eds). (2011). *The powerful garden: emerging views on the garden concept*. Garant, Antwerp-Apeldoorn. ISBN: 9789044127331

Díaz, S., Pascual, U., Stenseke, M., Martín-López, B., Watson, R.T., Molnár, Z., Hill, R., Chan, K.M.A., Baste I.A., Brauman, K.A., Polasky, S., Church, A., Lonsdale, M., Larigauderie, A., Leadley, P.W., van Oudenhoven, A.P.E., van der Plaats, F., Schröter, M., Lavorel, S., Aumeeruddy-Thomas, Y., Bukvareva, E., Davies, K., Demissew, S., Erpul, G., Failler, P., Guerra, C.A., Hewitt, C.L., Keune, H., Lindley, S., and Shirayama, Y. (2018). Assessing nature's contributions to people. *Science*, 359 (6373), 270-272.

Du Plessis, C. (2008). *Understanding cities as social-ecological systems*. World Sustainable Building Conference – SB'08, Melbourne, Australia, 21-25 September. Erişim adresi (11 Nisan

2019): http://www.dpi.inpe.br/Miguel/AnaPaulaDAlasta/DuPlessis_UnderstandingCitiesas%20SSEs_2008.pdf

Evans, T. and Caylor, K. (2009). *Spatial resilience in social-ecological systems: Household-level distribution of risk exposure and coping strategies in Eastern Province (Zambia)*. Resilience Project Report. Erişim adresi (11 Nisan 2019): http://www.chikyu.ac.jp/resilience/files/ReportFY2009/ResilienceProject_Report2009_16.pdf

Farinha-Marques, P., Fernandes, C., Guilherme, F., Lameiras, J.M., Alves, P., Bunce, R.G.H. (2017). Urban habitats biodiversity assessment (UrHBA): a standardized procedure for recording biodiversity and its spatial distribution in urban environments. *Landscape Ecology*, 32(9), 1753-1770.

Fischer, A.P. (2018). Forest landscapes as social-ecological systems and implications for management. *Landscape and Urban Planning*, 177, 138-147.

Fletcher, R., Baulcomb, C., Hall, C., Hussain, S. (2014). Revealing marine cultural ecosystem services in the Black Sea. *Marine Policy*, 50(Part A), 151-161.

Folke, C. (2006). Resilience: The emergence of a perspective for social-ecological systems analyses. *Global Environmental Change*, 16,253-267.

Folke, C., Carpenter, S.R., Walker, B., Scheffer, M., Chapin, T., and Rockstrom, J. (2010). Resilience thinking: integrating resilience, adaptability and transformability. *Ecology and Society*, 15(4).

Folke, C., Biggs, R., Norström, A.V., Reyers, B., and Rockström, J. (2016). Social-ecological resilience and biosphere-based sustainability science. *Ecology and Society*, 21(3), 41.

Gaffikin L. (2009). *Population growth, ecosystem services and human well-being*. Laurie Ann Mazu (Ed.), In: A Pivotal Moment: Population, Justice and the Environmental Challenge (124-135). Washington D.C.: Island Press.

Gallopín, G.C. (1991). Human dimensions of global change: linking the global and the local processes. *International Social Science Journal*, 43(4), 707-718.

Gunderson, L.H. and Holling, C.S. (Eds). (2002). *Panarchy: understanding transformations in human and natural systems*. Washington, D.C: Island Press.

Hadjikyriakou, G.N. & Hadjisterkotis, E. (2002). The adventive plants of Cyprus with new records of invasive species. *Zeitschrift fur Jagdwissenschaft*, 48, 59.

Hadjisterkotis, E. (2001). *The Cyprus mouflon, a threaten species in a biodiversity hotspot area*. Nahlik, A., & Uloth, W. (Eds.), In: Proceedings of the third international symposium on Mouflon, Sopron, Hungary (pp. 71–81).

Hall, A.D., & Fagen, R.E. (1956). Definition of system. II. *General systems*, 1, 18–28.

- Hassler, U. & Kohler, N. (2016). Resilience in the built environment. *Journal of Building Research & Information*, 42(2), 119–129.
- Heslinga, J.H., Groote, P., Vanclay, F. (2017). Using a social-ecological systems perspective to understand tourism and landscape interactions in coastal areas. *Journal of Tourism Futures*, 3(1), 23-38.
- Holling, C.S. (1973). Resilience and stability of ecosystems. *Annual Review of Ecology and Systematic*, 4, 1-23.
- Holling, C.S. (2001). Understanding the complexity of economic, ecological, and social systems. *Ecosystems*, 4, 390-405.
- Holling, C.S., Schindler, D.W., Walker, B.W. and Roughgarden, J. (1995). *Biodiversity in the functioning of ecosystems: an ecological synthesis*. C. Perrings, K.G. Mäler, C. Folke, C.S. Holling and B.O. Jansson (Eds.), *Biodiversity loss: economic and ecological issues* (pp. 44-83). Cambridge: Cambridge University Press.
- Homeland Security. (2016). Mitigation Framework Leadership Group (MitFLG) Draft Concept Paper, Draft Interagency Concept for Community Resilience Indicators and National-Level Measures. Published for Stakeholder Comment in June 2016. Erişim adresi (15 Nisan 2019): https://www.fema.gov/media-library-data/1466085676217-a14e229a461adfa574a5d03041a6297c/FEMA-CRI-Draft-Concept-Paper-508_Jun_2016.pdf
- Janssen, M.A., Anderies, J.M., Ostrom, E. (2007). Robustness of social-ecological systems to spatial and temporal variability. *Society and Natural Resources*, 20, 307-322.
- Kallaos, J., Wyckmans, A., & Mainguy, G. (2014). WP 2: Taxonomy of architecture and infrastructure indicators, D2.1: Synthesis review on resilient architecture infrastructure indicators (RAMSES project reference code: RAMSES-D2.1). Erişim adresi (16 Mayıs 2019): http://www.ramses-cities.eu/fileadmin/uploads/Deliverables_Uploaded/28022014_deliverable_ramses_d2_1.pdf
- KKTC Devlet Planlama Örgütü. (2013). KKTC Nüfus Sayımı, 2011. Bülten: Kesin Sonuçlar, İkinci Aşama. Resource document. Erişim adresi (28 Ekim 2018): http://www.devplan.org/Nufus-2011/nufus%20ikinci_.pdf
- Kotschy, K.A. (2013). *Biodiversity, redundancy and resilience of riparian vegetation under different land management regimes*. PhD Thesis, Johannesburg: University of the Witwatersrand.
- Kotschy, K., Biggs, R., Daw, T., Folke, C., West, P. (2015). *Principle 1 – Maintain diversity and redundancy*. R. Biggs, M. Schlüter, M.L. Schoon (Eds), *Principles for building resilience, sustaining ecosystem services in social-ecological systems* (pp. 50-79). Cambridge: Cambridge University Press.
- Leenhardt, P., Teneva, L., Kininmonth, S., Darling, E., Cooley, S., Claudet, J. (2015). Challenges, insights and perspectives associated with using social-ecological science for marine conservation. *Ocean & Coastal Management*, 115, 49-60.
- Leslie, P., and McCabe, J.T. (2013). Response diversity and resilience in social– ecological systems. *Current Anthropology*, 54, 114–143.
- Levin, S.A. (1998). Ecosystems and the biosphere as complex adaptive systems. *Ecosystems*, 1, 431–36.
- Lizarralde, G., Valladares, A., Olivera, A., Bornstein, L., Gould, K., Barenstein, J.D. (2014). A system approach to resilience in the built environment: The case of Cuba. *Journal of Disasters*, 39(S1), S76–S95.

- Longstaff, P.H., Keli Perrin, A., Parker, W.M., Hidek, M.A. (2010). Building resilient communities: A preliminary framework for assessment. *Homeland Security Affairs*, Volume VI, No. 3.
- MA (Millennium Ecosystem Assessment). (2005). *Ecosystems and human well-being: Synthesis.*, Washington D.C.: Island Press.
- Maruyama, H. (2016). *Taxonomy and general strategies for resilience*. Yamagata Y and Maruyama H (Eds), In: Urban resilience – a transformative approach (pp.3-21). Springer International Publishing Switzerland.
- McNeely J.A. (2010). People, Ecosystems and Climate: Governance Risks from the Degradation of Ecosystem Services in the Face of Ongoing Climate Change. IRGC-Emerging Risks, McNeely. October 2010. Erişim adresi (18 Şubat 2019): https://irgc.org/wp-content/uploads/2012/04/ER_and_Ecosystem_Services_McNeely.pdf
- McPhearson, T., Hamstead, Z.A., Kremer, P. (2014). Urban ecosystem services for resilience planning and management in New York City. *AMBIO*, 43, 502-515.
- Mele, C., Pels, J., Polese, F. (2010). A brief review of systems theories and their managerial applications. *Service Science*, 2(1-2), 126-135.
- Mijatović, D., van Oudenhoven, F., Eyzaguirre, P., Hodgkin, T. (2013). The role of agricultural biodiversity in strengthening resilience to climate change: towards an analytical framework. *International Journal of Agricultural Sustainability*, 11(2), 95-107.
- Myers, N., Mittermeier, R.A., Mittermeier, C.G., de Fonseca, G.A.B., & Kent, J. (2000). Biodiversity hotspots for conservation priorities. *Nature*, 403, 853–858.
- Nassauer, J.I. (1995). Culture and changing landscape structure. *Landscape Ecology*, 10(4), 229–237.
- Nassauer, J.I. (1997). *Cultural sustainability - Aligning aesthetics and ecology*. J. I. Nassauer (Ed.). Placing nature - culture and landscape ecology (pp. 67–83). Washington, DC: Island Press.
- Norris, K. (2012). Biodiversity in the context of ecosystem services: the applied need for systems approaches. *Philosophical Transactions of the Royal Society B*, 367(1586), 191–199.
- Nyström, M. and Folke, C. (2001). Spatial resilience of coral reefs. *Ecosystems*, 4, 406–417.
- Ostrom, E. (2007). *Sustainable social-ecological systems: An impossible?* Presented at the 2007 Annual Meetings of the American Association for the Advancement of Science, "Science and Technology for Sustainable Well-Being," 15–19 February in San Francisco, USA. Erişim adresi (15 Mayıs 2019): <https://pdfs.semanticscholar.org/c546/a1a26b8f89c849e803fe2dae404734aedc46.pdf>
- Pahl-Wostl, C. (2007). The implications of complexity for integrated resources management. *Environmental Modelling and Software*, 22, 561–69.
- Perrings, C. (2006). Resilience and sustainable development. *Environment and Development Economics*, 11, 417-427.
- Peters, D.P.C., Bestelmeyer, B.T., Turner, M.G. (2007). Cross-scale interactions and changing pattern-process relationships: Consequences for system dynamics. *Ecosystems*, 10, 790-796.
- Petrosillo, I., Aretano, R. and Zurlini, G. (2015). *Socioecological systems*. Scott A. Elias (Ed.), In: Reference Module in Earth Systems and Environmental Sciences. Doi: 10.1016/B978-0-12-409548-9.09518-X.

- Pickett, S.T.A., Burch, W.R., Dalton, S.E., Foresman, T.W., Grove, J.M., Rowntree, R. (1997). A conceptual framework for the study of human ecosystems in urban areas. *Urban Ecosystems*, 1, 185-199.
- Plieninger, T. and Bieling, C. (2012). *Connecting cultural landscapes to resilience*. Plieninger T. and Bieling, C. (Eds.), In: Resilience and the cultural landscape: Understanding change in human-shaped environments pp. 3-26). Cambridge: Cambridge University Press.
- Plummer, R. and Armitage, D. (2007). A resilience-based framework for evaluating adaptive eco-management: linking ecology, economics and society in a complex world. *Ecological Economics*, 61(1), 62-74.
- Polegri, L. and Negri, V. (2010). Molecular markers for promoting agro-biodiversity conservation: a case study from Italy how cowpea land races were saved from extinction. *Genetic Resources and Crop Evolution*, 57(6), 867-880.
- Preiser, R., Biggs, R., De Vos, A. and Folke, C. (2018). Social-ecological systems as complex adaptive systems: organizing principles for advancing research methods and approaches. *Ecology and Society*, 23(4), 46.
- Ruhl, J.B. and Stuart Chapin, F. (2013). *Ecosystem services, ecosystem resilience, and ecosystem management policy*. Craig R. Allen and Ahjond S. Garmestani (Eds.), In: Resilience and Law. Columbia University Press, 2013, Vanderbilt Public Law Research Paper No. 12-41. Erişim adresi (2 Ekim 2018): <https://ssrn.com/abstract=2181093>
- Sanderson, E.W., Redford, K.H., Vedder, A., Coppolillo, P.B., Ward, S.E. (2002). A conceptual model for conservation planning based on landscape species requirements. *Landscape and Urban Planning*, 58, 41–56.
- Sarkki, S., Ficko, A., Wielgolaski, F.E., Abraham, E.M., Bratanova-Doncheva, S., Grunewald, K., Hofgaard, A., Holtmeier, F.K., Kyriazopoulos, A.P., Broll, G., Nijnik, M., Sutinen, M.L. (2017). Assessing the resilient provision of ecosystem services by social-ecological systems: introduction and theory. *Climate Research*, 73(1). Doi: 10.3354/cr01437
- Schipper, E. L. & Langston, L. (2015). *A comparative overview of resilience measurement framework, analysing indicators and approaches*. Overseas Development Institute Working Paper 422.
- Scholz R W, Binder C.R, and Lang D.J. (2011). *The HES Framework*. R. W. Scholz (Ed.), In: Environmental literacy in science and society: from knowledge to decisions (pp. 453-462). Cambridge: Cambridge University Press.
- Scott L. (2015). Systems theory terms. 20th November 2015. Erişim adresi (14 Aralık 2018): <https://www.lesswrong.com/posts/DshBToGnNbTBD7BSw/systems-theory-terms>
- Sharifi A and Yamagata Y. (2016a). *Urban resilience assessment: multiple dimensions, criteria, and indicators*. Yamagata Y and Hiroshi M (Eds), In: Urban Resilience (pp. 259-276).Springer International Publishing. Doi: 10.1007/978-3-319-39812-9_13
- Sharifi, A., & Yamagata, Y. (2016b). Principles and criteria for assessing urban energy resilience: A literature review. *Renewable and Sustainable Energy Reviews*, 60, 1654–1677.
- Smith, R.M., Thompson, K., Hodgson, J.G. (2006). Urban domestic gardens ix: composition and richness of the vascular plant flora, and implications for native biodiversity. *Biological Conservation*, 129, 312-322.
- Suárez, M., Gómez-Baggethun, E., Benayas, J., Tilbury, D. (2016). Towards an urban resilience index: A case study in 50 Spanish cities. *Sustainability*, 8, 774.

- Tengberg, A., Fredholm, S., Eliasson, I., Knez, I., Saltzman, K., Wetterberg, O. (2012). Cultural ecosystem services provided by landscapes: Assessment of heritage values and identity. *Ecosystem Services*, 2, 14-26.
- Tomaselli R. (1977). The degradation of the Mediterranean maquis. *Ambio* 6(6), The Mediterranean: A Special Issue: 356-362. Erişim adresi (18 Mart 2019): <https://www.jstor.org/stable/4312322>
- Turner, B.L., Kasperson, R.E., Matson, P., McCarthy, J.J., Corell, R.W., Christensen, L., Eckley, N., Kasperson, J.X., Luers, A., Martello, M.L., Polsky, C., Pulsipher, A., Schiller, A. (2003). A framework for vulnerability analysis in sustainability science. *Proceedings of the National Academy of Sciences*, 100(14), 8074-8079.
- UNESCO-FAO. (1969). *Ecological study of the Mediterranean zone: vegetation map of the Mediterranean zone-explanatory notes*. In: Arid Zone Res, 30:90 Erişim adresi (15 Mayıs 2019): <http://unesdoc.unesco.org/images/0007/000700/070037mo.pdf>
- Unnasch, R.S., Braun, D.P., Comer, P.J., Eckert, G.E. (2008). *The ecological integrity assessment framework: A framework for assessing the ecological integrity of biological and ecological resources of the National Park System*. Report to the National Park Service. Erişim adresi (15 Mayıs 2019): <http://npshistory.com/publications/eq/rmp/ecological-integrity-framework.pdf>
- UNU-IAS (United Nations University Institute of Advanced Studies). (2013). *Indicators of resilience in socio-ecological landscapes (SEPLs)*. UNU-IAS Policy Report (Authors: Bergamini N., Blasiak R., Eyzaguirre, Ichikawa K., Mijatovic D., Nakao F., Subramanian S.M.). Yokohma: Japan. Erişim adresi (21 Ağustos 2018): http://archive.ias.unu.edu/resource/centre/Indicators-of-resilience-in-sepls_ev.pdf
- Vural M., Zeydanlı, U.U., Beton, D., Meraklı, M.K. (2010). *Determining core areas of floral species richness in the Karpaz Peninsula (Cyprus)*. TOP Biodiversity2010—conference Proceedings, Intercollege-Larnaca, Cyprus, pp.154–155.
- Walker, B.H. (1992). Biodiversity and ecological redundancy. *Conservation Biology*, 6, 18–23.
- Walker, B.H. (1995). Conserving biological diversity through ecosystem resilience. *Conservation Biology*, 9, 747–752.
- Walker, B., Carpenter, S., Anderies, J., Abel, N., Cumming, G., Janssen, M., Lebel, L., Norberg, J., Peterson, G., Pritchard, R. (2002). Resilience management in social-ecological systems: a working hypothesis for a participatory approach. *Conservation Ecology*, 6,14.
- Walker, B., Holling, C.S., Carpenter, S.R. and Kinzig, A. (2004). Resilience, adaptability and transformability in social-ecological systems. *Ecology and Society*, 9(2).
- Walker, B. H., and Salt D. (2006). *Resilience thinking: Sustaining ecosystems and people in a changing world*. Washington, DC: Island Press.
- Whitney, C. K., N. J. Bennett, N.C. Ban, E. H. Allison, D. Armitage, J.L. Blythe, J.M. Burt, W. Cheung, E.M. Finkbeiner, M. Kaplan-Hallam, I. Perry, N.J. Turner, and L. Yumagulova. (2017). Adaptive capacity: from assessment to action in coastal social-ecological systems. *Ecology and Society*, 22(2), 22.
- Wiens, J.A. (1999). *Toward a unified landscape ecology*. Wiens J.A & Moss M.R. (Eds.), In: Issues in landscape ecology (pp. 148–151). Snowmass Village, USA: International Association for Landscape Ecology.