

TOWARDS SUSTAINABLE LANDSCAPE DEVELOPMENT INDICATORS FOR NORTH CYPRUS*

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Abstract

The aim of this study is to develop a conceptual framework that can assist in selecting and filtering a set of sustainable landscape development indicators for North Cyprus. Such indicators can provide opportunities to understand, monitor, measure and evaluate whether we are on the path towards sustainable development in the region or not. The method of the study was based upon a review of relevant studies. In the first section of the study, the concept of sustainable landscape development is examined in terms of improving the quality of life while landscapes maintain their functions. This evaluation shows that sustainable landscape development should include five pillars (environmental, economic, social, political and aesthetic sustainability) to achieve a balance between human and ecological systems. The second section of the study focuses on the types and relevance of indicators for sustainable landscape development. This assessment shows that multi-functional landscape development indicators are needed for evaluating landscape pressures, conditions and potential responses. Development and implementation of such indicators can contribute to the long-term viability of the interaction between biodiversity conservation, agricultural production and survival of local livelihoods in North Cyprus. In the last section, a comprehensive set of sustainable landscape development indicators is proposed for North Cyprus. These indicators include: environment (e.g. number of vascular plant species), economy (e.g. diversity in agricultural land types), socio-culture (e.g. degree of access to clean drinking water), visual (e.g. degree of aesthetic pleasing), policy (e.g. degree of effective implementation of the European Landscape Convention) and green infrastructure (e.g. trends in rainwater harvesting at community level). It is expected that the proposed indicators can serve as a benchmark for policy-makers and natural resource managers in terms of sustainable use of natural resources, ecological, economic and socio-cultural development in North Cyprus.

Keywords: Sustainability; landscape indicator; sustainable landscape development; landscape assessment; North Cyprus.

1. Introduction

The global population growth and the need for more land have led to the conversion of natural ecosystems into residential, industrial and agricultural areas. That means we live in a world where only a small percentage of land remains relatively unused today. Therefore, these areas should be protected for their vital ecosystem goods and services. Despite all efforts (e.g. World Summit on Sustainable Development Johannesburg-2002), dramatic threats have been continuing on the environment and natural resources. This situation illustrates a serious failure to integrate environmental, social and development priorities into global economic policy [42]. Concrete actions are needed more than ever for minimizing the threats on the environment as well as for controlling the relevant impacts of socio-economic crises at global level. The needs for such actions and the world economic crisis in 2008 have resulted in the call for another Summit; Rio+20 UN Sustainable Development Earth Summit in 2012.

One of the fundamental themes of the Summit 2012 is Green Economy that addresses reducing the impacts of global economic crisis by linking proposed strategies with priorities in climate change, protection of ecosystems and natural resources [46]. Accordingly; international and national legislations and agendas required new arrangements to support and encourage environmentally friendly and economically viable new approaches in all relevant fields including landscape development. Such arrangements should particularly be focused in more sensitive and fragile regions such as arid and semi-arid zones and island ecosystems. Cyprus, being a typical semi-arid Mediterranean Island, can serve as a significant case.

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Cyprus is located on the Eastern part of the Mediterranean Sea. The Island has diverse landscapes due to its climatic variations, geological features and proximity to three continents; Asia, Africa and Europe. The dominating rural landscape represents a mosaic of natural and semi-natural habitats (e.g. Mediterranean shrubs maquis). Particularly drought, salinisation and water shortage have led to serious degradation on the cultural landscapes [10]. Maintenance of these landscapes is necessary for meeting the needs of present and future generations – the concept of sustainable development. For that reason, we need a set of landscape development indicators (instruments which show whether landscapes are changing for the better or for the worse) [11]. Accordingly; the overall aim of this study is to develop a conceptual framework that can assist in selecting and filtering a comprehensive set of sustainable landscape development indicators for North Cyprus. It is expected that the proposed indicators can serve as a benchmark for policy-makers and natural resource managers in terms of sustainable use of natural resources, ecological, economic and socio-cultural development in North Cyprus.

The Concept of Sustainable Landscape Development

The concept of sustainability has been keeping its place in the international agenda since the Brundtland Commission of the United Nations on March 20, 1987. According to the World Commission on Environment and Development (WCED) (1987) [53]; the term *sustainability* refers to meet the needs of the present without compromising the ability of future generations to meet their own needs. Efforts to build a truly sustainable way of life require the integration of actions in three key areas: economic growth, conservation of natural resources and social development [43, 44, 54]. Therefore, the concept of sustainability is widely accepted as a strategic framework for decisions on the future use of lands [18].

Although the concept of sustainable landscape is relatively recent, it is increasingly becoming evident that landscape is a highly promising scale for sustainable development [24]. Sustainable landscape development aims to benefit from ecosystem services while meeting societal needs and respecting societal values [28, 55]. Therefore, a holistic approach to landscape development should include biological, physical and human components [5, 29, 33]. The sustainability of landscapes can be developed if the three pillars of sustainability – environment, economy, and society – are simultaneously considered [6]. However, many authors draw attention to a fourth pillar, political sustainability [40] whereas designers emphasize aesthetic sustainability. Thus, we propose that sustainable landscape development should include five pillars in order to achieve a balance between human and ecological systems (Figure 1).

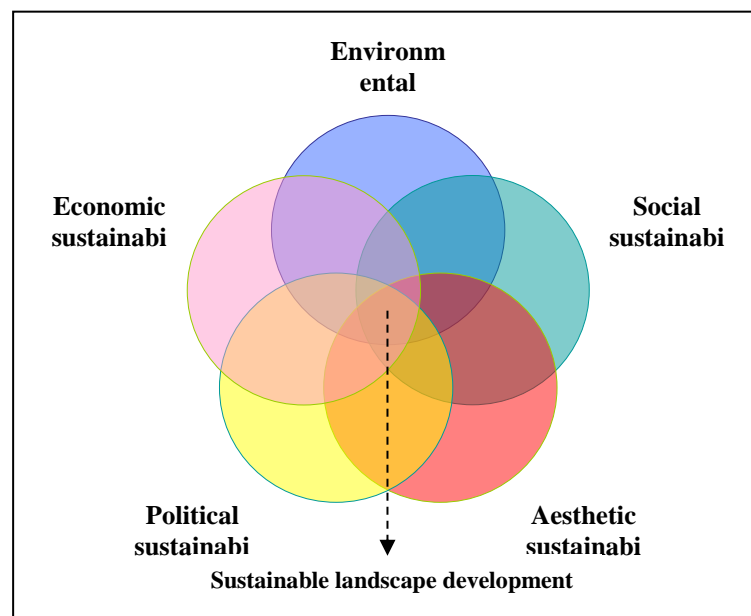


Figure 1. Five pillars of sustainable landscape development

Environmental sustainability in landscape development refers to the ecological dimension of landscapes and related to landscape ecology. Landscape ecology focuses on landscape structures, functions and changes. Landscape functions provide ecosystem services such as nutrient cycling and flood control. Understanding this system is essential for rational land use planning, management of biodiversity conservation and sustainable landscape development [17, 28]. *Economic sustainability in landscape development* can be expressed as the maintenance of the attractive features of landscapes to support tourism and recreation. It deals with monetary investments and their profitability [17]. Maintenance of natural

and cultural landscapes should make the local area attractive to outsiders and provide benefits for local people by creating jobs (e.g. ecotourism), tackling local markets and supporting environmental practices. *Social sustainability in landscape development* is related to active participation of all relevant stakeholders in decision-making, social learning and improving well-being processes. *Political sustainability in landscape development* refers to governance mechanisms such as European Landscape Convention and EU Water Framework Directive. *Aesthetic sustainability in landscape development* is related to the maintenance of visual quality and outstanding scenic features of landscapes [40]. Sustainability in landscape development is a process. This process can be achieved by providing a balance among the five pillars of landscapes explained above.

2. Indicators of Sustainable Landscape Development

An indicator is a piece of evidence or signal that reflects the state of conditions being measured [2, 49]. Indicators show changes over time for each criterion and demonstrate the progress made towards its specified objective. Indicators, which are derived from data, are commonly the first and most basic tools for analyzing changes. Firstly, they can work as a basis for assessment by providing information on conditions and trends of sustainable development. Secondly, as a basis for such assessments, indicators can provide input to policy formulation processes. They are the means to an end, consisting of improved decision-making and early warning system to prevent economic, social and environmental setbacks [39].

Indicators have been used as a tool with which more information can be obtained about issues as varied as people's health, economic welfare, environmental quality and sustainable development [39]. Several proposals of conceptual frameworks for sustainable development indicators exist [31, 32, 45]. These frameworks generally point out the ecological, economic, social and institutional factors that influence sustainability. Landscape and relevant issues are not mentioned in these frameworks, but changes in landscape structures and functions directly/indirectly affect the ecological, economic and socio-cultural factors of sustainability. Therefore; landscape indicators should be developed for evaluating spatial changes, landscape structures and functions, pressures, adopting measures and integrating relevant responses.

A number of studies [1, 3, 4, 9, 12, 13, 14, 16, 21, 26, 30, 35, 50] were carried out to generate landscape development indicators. Only a few of these studies [3, 9, 12] considered landscape structures and functions as indicators. A number of studies [3, 4, 13, 49, 51] developed indicators for a particular landscape character such as agriculture landscape indicators [49] and visual landscape indicators [15]. However, none of these studies included all aspects of landscapes. Thus, there is a need for a system of multi-functional indicators in landscape development. The system of indicators should include all pillars of landscapes mentioned (e.g. ecological, economic, socio-cultural, political and aesthetic indicators) in order to evaluate landscape pressures, trends, conditions and responses.

3. Potential Indicators for Sustainable Landscape Development in North Cyprus

Landscapes change rapidly and continuously, particularly in highly urbanized areas. These changes cause a significant loss of biodiversity, features of cultural landscapes and sense of place. For that reason; programs have been conducted to inventor and assess landscapes and to monitor changes at national and Pan-European levels [13]. Within this context; we need a system of multi-functional indicators to help landscape managers and planners identify, monitor and assess the effects of change on landscapes and their functions. This is particularly important for fragile island ecosystems such as North Cyprus (Figure 2 and 3). We consider that sustainable landscape development in North Cyprus should provide the long-term viability of the interaction of biodiversity conservation, agricultural production, survival of livelihoods and protection of aesthetic features. Here we propose a set of multi-functional landscape development indicators for North Cyprus. We have used the administrative boundaries as the scale. The multi-functional landscape development indicators include a holistic approach in terms of integrating the ecological, economic, socio-cultural, political and aesthetic components. The following literatures were reviewed for developing the proposed indicators: [1, 2, 4, 9, 11, 12, 13, 14, 16, 20, 21, 22, 26, 30, 31, 32, 34, 35, 36, 38, 39, 41, 45, 47, 49, 50]. The proposed indicators are presented in Table 1, 2, 3, 4, 5 and 6.



Figure 2. Cyprus Island, comprises Turkish and Greek sites

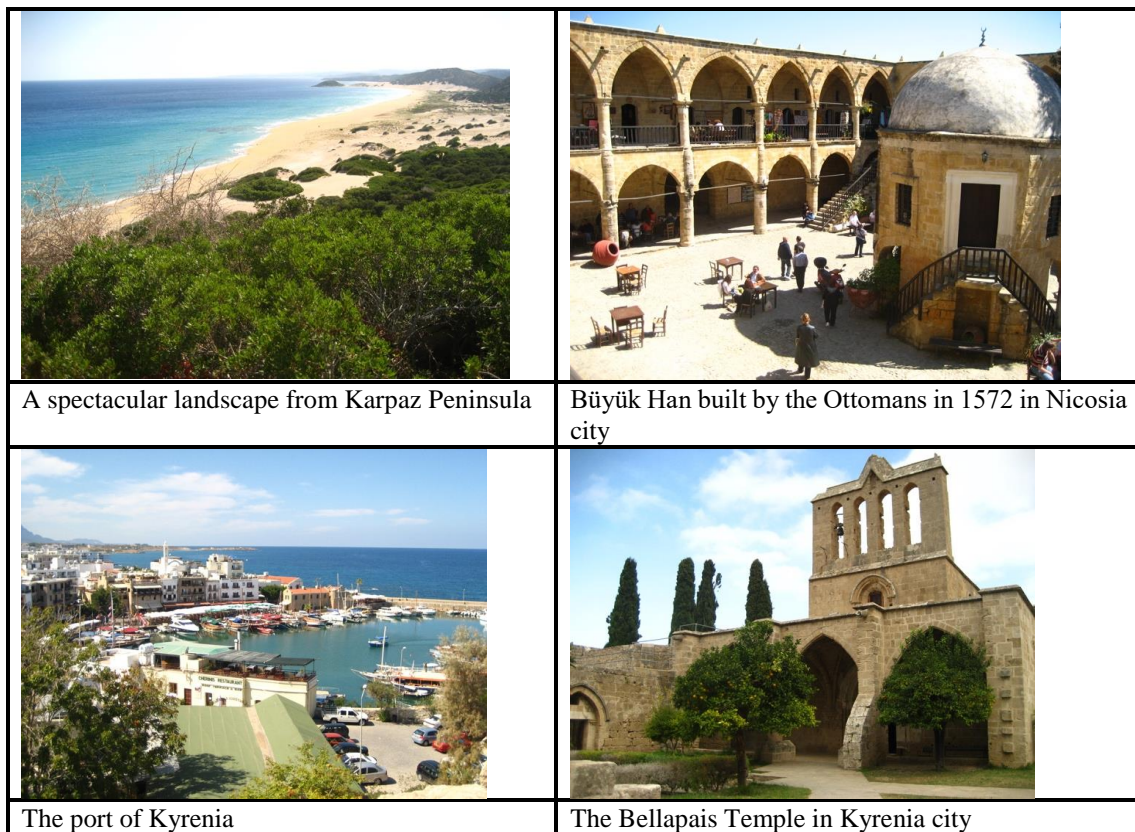


Figure 3. Few landscape examples from North Cyprus

Environment related indicators for sustainable landscape development

Atmosphere is a key component of landscapes. Air quality is directly interrelated with vegetation and green space components. Thus; increase in these components directly contributes to air quality. There are two main issues to achieve such an outcome. The first is to minimize the emissions of transportation and industries. The second is to create more green spaces (e.g. urban forest and rooftop gardens) [22]. *Soil* is another major component of landscapes that directly affects biodiversity, vegetation, flora and fauna. Soil fertility indicates soil quality that is the capacity of a specific soil type to function within natural and managed ecosystem boundaries. Soil quality is very important for land quality and sustainable land management [11] and it can be increased by organic matter [19, 37, 41] and crop rotation in agricultural landscapes [1]. *Fresh water* is another major component of landscapes. Fresh water helps to deliver ecosystem goods

(e.g. drinks) and services (e.g. nutrient cycling) [26]. BOD (Biochemical Oxygen Demand) in water bodies and pH values are the two major indicators that help us measure water quality. The results of analysis of the annual withdrawal of ground and surface water as a percent of total available water can provide information about the total water quantity. *Vegetation and flora* are also among the major components of landscapes. The number of vascular species and degree of protection can directly contribute to the protection and maintenance of biodiversity in North Cyprus. Occurrence of ecotones (rich areas in biodiversity) is important in terms of providing connectivity between ecosystems. Therefore, number and state of ecotones should be considered as key indicators in the sustainable landscape development in the region. Degree of naturalness is also a key indicator in terms of measuring changes in vegetation cover and landscape structure (Table 1).

Table 1. Environmental indicators for sustainable landscape development in North Cyprus

Landscap component	Theme	Indicator
Atmosphere	Air quality	Concentration level of air pollutants in landscapes
	Climate change	Emissions of greenhouse gases
Soil	Soil fertility	-Percentage of compost and mulch production at community level
		-Degree of yield productivity
		-Current trends in crop rotations
Fresh water (surface and ground)	Water quality	-pH value -BOD in water bodies
	Water quantity	-Annual withdrawal of ground and surface water as a percent of total available water
Vegetation and flora	-Flora	-Number of vascular plant species
	-Rare/protected/endangered species	-Degree of protection
	-Ecotones (edges)	-Number and state of ecotones
	-Vegetation cover	-Degree of naturalness
Wildlife/ Fauna	-Abundance and distribution of populations and species	-Degree of population dynamics and species
	-Rare/endangered/protected species	-Degree of protection
Biodiversity	-Rare, threatened and protected habitats	-Degree of protection
	-Habitat suitability	-Occurrence and size of habitats
	-Habitat quality	-Degree of population recovery capacity
Green space	-Establishment and maintenance of urban forest	-Percentage of urban forest
	-Protection of local animal and plant species	-Degree of protection
	-New landscape plantings	-Level of increase in green areas

Wildlife populations and species play a significant role in natural ecological processes. Landscape fragmentation and land use change adversely affect abundance and distribution of species and populations. Therefore, suitable habitats should be protected and also be linked by an ecological corridor to maintain population dynamics. *Biodiversity* refers to diversity in major habitats. Habitat suitability and quality as well as the degree of protection of the species can contribute to the maintenance of biodiversity in North Cyprus. *Green spaces* provide a wide range of benefits. Accordingly, we propose three key indicators. The first and most important one is to create and maintain urban forests. According to American Forest Foundation, cities must maintain urban canopy tree coverage of 49% to ensure clean water, clean air and to mitigate the effects of urban heat islands. Additionally, urban forests are integral parts of large cities, rural areas, streets, backyards, parks and open spaces. Urban forests provide shade, beauty, and habitat for urban wildlife and promote biodiversity in urban areas [22]. The establishment of urban forests can reduce heating and cooling costs, storing rainwater, improving air quality and increasing property values and local tax bases. Local animal and plant species and their habitats should be protected and maintained within this context. Establishment of new landscapes (e.g. parks) should also be supported for creating and increasing the benefits of green spaces.

Economy related indicators for sustainable landscape development

Major economic activities in North Cyprus are based on agriculture, tourism and education. Within the context of sustainable landscape development indicators, we consider two major land use types: agriculture and tourism (Table 2). *Agriculture* may be used as a way to enhance economic performance while maintaining the quality and environmental functions of the natural resource base. We should support sustainable agricultural programmes such as permaculture and sustainable agriculture to maintain ecosystem goods and services delivered by agricultural lands. The indicator of *diversity* refers to diversity of agricultural land use types (agro-diversity). It describes the degree of diversification of production

systems over the landscape, including livestock and agroforestry systems. It reflects the degree of flexibility (resilience) of regional farming systems and their capacity to absorb shocks and respond to opportunities [11]. *Biodiversity* in agricultural landscapes can improve the soil fertility in agro-ecosystems as well [1]. Abundance and distribution of farmland birds increase the degree of biodiversity in agricultural lands. Protection of existing and establishment of new biotopes can also increase biodiversity in agricultural landscapes. Plant production (farming systems) is one of the major functions of agricultural lands. Crop species diversity can contribute to increasing soil and water quality, biodiversity and land conservation. Therefore, initiatives for crop species diversity should be supported at community level. *Farm management* describes the use of farm inputs and environment friendly practices at community level. Permaculture and organic agriculture practices should be supported in rural areas as an alternative model to conventional agriculture. Percent of agro-chemical use at crop level is a major issue in farm management as overuse of agro-chemicals can adversely affect water and soil quality, biodiversity and wildlife habitats. Therefore, their use should be controlled at crop level. Due to water shortage, drought efficient irrigation systems and water saving techniques should be supported in the agricultural sector in the region. Grey water can be another alternative to save water and to use the saved water in agriculture and landscaping. A high volume of waste plant material is produced every year in agricultural fields. Waste management initiatives including compost and mulch production at community level should be encouraged. Such initiatives may provide valuable contributions to soil formation process, soil fertility and recycling plant materials. Income generation from the agriculture sector is the most important subject for farmers. Amount of income generated per hectare in a year is proposed as an indicator for determining the state of income generation at household level. *Tourism* is a significant industry in Cyprus Island. However, this sector is particularly based on casinos and package holidays in North Cyprus. It is mostly foreign investment that is benefiting from advantages of tourism sector. Sustainable tourism initiatives such as ecotourism should be supported to deliver the benefits of tourism at environmental and community levels. The relevant indicators of proximity to natural areas, distance to main roads and accessibility can contribute to increasing the awareness of visitors. The other two indicators; ‘amount of income and job generated from tourism at community level’ can help measuring the degree of socio-economic benefits obtained from tourism sector at community and household level.

Table 2. Economic indicators for sustainable landscape development in North Cyprus

Type of land	Theme	Indicator
Agriculture	Diversity	Diversity in agricultural land types
	Biodiversity	-Small biotopes in agricultural areas
		-Abundance of farmland birds
		-Distribution of farmland birds
	Farming systems (plant production)	-Degree of crop species diversity
	Farm management	-Trends in permaculture
		-Trends in organic agriculture
		-Percent of agro-chemical use at crop level
	Efficient irrigation systems & water saving systems	Trends in use of drip irrigation system
		Trends in grey water use
Waste management	Percent of plant material recycled at community level	
Income generation	Amount of income generated per hectare in a year	
Tourism	Recreation/tourism	-Proximity to natural areas
		-Distance to main roads
		-Facilities/units
		-Amount of jobs created from tourism at community level
		-Amount of income generated from tourism at community level
	-Accessibility	

Socio-culture related indicators for sustainable landscape development

The indicators related to the socio-cultural pillars of landscapes in North Cyprus are summarized in Table 3 below. Population dynamic and health are the two major issues related to the social dimension of landscapes. Population dynamic can give us information about the long-term changes in population size, immigration rate, age profile and so on. Health refers to the possibility of access to clean drinking water and sanitation services. Relevant initiatives are important to increase life quality in the region. The issue of natural experience within the context of sustainable tourism should be supported for increasing the awareness of visitors on the landscape functions and structures. Within the context of education, the indicator ‘number of classes about landscapes in schools’ can be a strong tool for increasing the awareness of school kids on the landscape structures and functions. Traditional knowledge refers to the ‘knowledge, innovations and practices of indigenous and local communities around the world [Article 8(j) and 18.4 of the Convention on Biological Diversity] [7]. This knowledge is highly valuable in terms of conservation of biodiversity, socio-economic and cultural

development. Culture refers to ‘the total sum of ways of living built up by a group of human being and transmitted from one generation to another’ [27]. We can group cultural resources as tangible (e.g. traditional handicrafts) and intangible (e.g. traditional knowledge). Such cultural resources not only shape landscape structures but also constitute cultural identity of the society. The issue of ‘sense of place’ refers to a feeling or perception held by people about special geographical places with characteristic features. The sense of place may be strongly enhanced by the place being written about by poets or portrayed in art or music [52]. Number of areas with outstanding beauty, heritage sites, sacred sites and cultural centers can help us to measure the level of ‘sense of place’ the region.

Table 3. Socio-cultural indicators for sustainable landscape development in North Cyprus

Landscape related theme	Theme	Indicator
Social	Population dynamic	Degree of population density per km ² within normal standards
	Health	-Degree of access to clean drinking water -Degree of access to sanitation services
	Natural experience	Degree of increase in valuing functions and structures of landscapes
	Education	Number of classes about the issue of landscape in schools
	Traditional knowledge	-Existence of traditional knowledge regarding landscape management and restoration practices -Trends in adaptation of traditional knowledge into landscape management policies
	Participation in decision-making	Degree of participation in landscape design, protection and management
Culture	Cultural identity	-Trends in maintaining traditional diet and production systems -Trends in maintaining traditional consumption systems -Trends in production and use of traditional handicrafts -Number of traditional music, songs, instruments and dances
	Sense of place	-Number and distribution of areas with outstanding beauty -Number and distribution of identified heritage sites -Number and distribution of archaeological sites -Number of cultural centres -Number of sacred sites

Visuality related indicators for sustainable landscape development

Visuality is related to the issue of ‘aesthetic’ in philosophy. The visual landscape is one of the major realms where the work of planners, designers and managers directly interacts with public perceptions and expectations. Human perceptions of the landscape change due to the influence of economic, social, aesthetic and ethical factors. Relevant indicators are presented in Table 4.

Table 4. Visuality related indicators for sustainable landscape development in North Cyprus

Landscape component	Theme	Indicator
Visuality	Aesthetic experience	-Degree of aesthetic pleasing
	Visual quality	-Landscape preferences

Aesthetic experience can be defined as ‘aesthetic pleasing of individuals obtained from landscapes’. We consider that aesthetic experience can not only be obtained from active and passive recreational activities but also can be provided by increasing knowledge and awareness of individuals on landscape structures and functions. *The visual quality* of a landscape can be defined as ‘the relative aesthetic excellence of a landscape’ and examined in terms of observer appreciation [8, 23, 25].

Policy related indicators for sustainable landscape development

Policy indicators simply show the presence or absence of institutions, laws, regulations or strategies [35] (Table 5). The major policies about providing and maintaining the sustainability of landscapes include the EU Landscape Convention

and the EU Water Directive. Adoption of these instruments and also strength of relevant national policies and institutions can contribute to the sustainability of landscape development in North Cyprus.

Table 5. Policy related indicators for sustainable landscape development in North Cyprus

Landscape related theme	Theme	Indicator
Policy	Adoption of the EU Landscape Convention	Degree of effective implementation of the Convention
	Adoption of the EU Water Directive	Degree of effective implementation of the Directive
	National policies	Existence and degree of effectiveness of national policies regarding sustainable landscape development
Institution	Ability of institutions to implement sustainable landscape development	-Degree of efficiency of institutions in implementation of sustainable landscape development

Green infrastructure related indicators for sustainable landscape development

Green infrastructure related indicators are needed to establish a link required between the five pillars of sustainable landscape development. Green infrastructure indicators are particularly crucial in urban areas to promote the quality of life of citizens, to reduce the consumption of resources (e.g. soil, water and energy) and to control the expansion of urban areas (Table 6).

Table 6. Green infrastructure indicators for sustainable urban landscape development in North Cyprus [Adapted from 36]

Landscape related theme	Theme	Indicator
Sustainable transportation	Mobility	-Bus lines -Bicycle km/unit -Pedestrian streets
	Air	-Air quality -Emission reduction
Efficient energy consumption	Solar system	-Percent of energy produced from solar system at community level
Sustainable water management	-Rainwater harvesting	-Trends in rainwater harvesting at community level
	-Greywater use	-Trends in greywater use at community level
Sustainable waste management	-Centralized recycle programs	-Selective collection of waste and recycling
	-Backyard composting	-Trends in backyard composting at community level

Transportation has positive (e.g. economic and social development) and negative (e.g. air pollution, climate change, energy user, depletion of natural resources) effects on human well-being [22]. Within this context; we suggest that bus lines, walking and biking systems should be supported within the context of sustainable landscape development in North Cyprus. Solar energy is widely used for water heating in North Cyprus. However, innovative techniques based on solar energy should be supported and developed for heating and cooling insides as a great amount of energy is consumed for this reason in North Cyprus. Water resources are precious to human being. To ensure the water resource to meet the demands of the future, immediate improvements are needed in techniques for water conservation, storage, treatment and reuse [22]. Within this context; we propose two approaches (rainwater harvesting and treatment of greywater) for sustainable water management in North Cyprus. Rainwater harvesting is a technique that collects rainwater from impervious surfaces and stores it for later use [48]. Rainwater harvesting is necessary for water conservation and development of alternative water supplies in the Island. Greywater generally refers to untreated water from washing machines, bathtubs, showers, bathrooms, toilet and kitchen sinks. Such water can be biologically treated and then can be reused on the landscape outside and in toilets inside [37]. Waste management is a key issue to be addressed in sustainable landscape development. Accordingly, new developments are needed to minimize the generation of waste and to maximize the ability to reuse and recycle. Within this context; centralized recycle programs should be developed. Backyard composting should be encouraged so that people can produce their own compost and use it in landscape maintenance.

4. Conclusion

Sustainability is a common goal for human well-being and therefore increasingly become dominate in landscape planning and management. Although sustainability can include a plan, the major challenge will require a change in mind-set, a change in values toward less consumptive lifestyle, rethinking our environment, reducing pollution,

recycling and reusing energy in North Cyprus. In addition; time is the key to sustainability. Therefore, the government should have a long time frame to create sustainable landscapes, because major current problems cannot be solved within one generation in North Cyprus. Sustainable landscape development in the region particularly depends on the land management. Conflicts in the land management resulting from political issues should be solved to achieve the objectives of sustainable landscape development in the Island. The system of the proposed indicators can be used as a framework by those who are concerned with describing landscapes and landscape changes at local and national scales. Application of the indicators would particularly reflect the relation between agriculture and environment and relevant policies. For that reason, a project for the development of local agro-environmental programmes for biodiversity and landscape conservation should be initiated at the Island level.

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