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ORIGINAL ARTICLE

Association of urban green spaces with urban ecological zones

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ABSTRACT

Today urban development lacks ecological foundations in many cities of Turkey. The purpose of this study is to reveal the relationship between urban green spaces and ecological zones in the sample of Aksaray/Turkey. In this study, a study design has been created to improve the urban ecological infrastructure and to associate the green space network with the ecological zones. This design is divided into four parts as data processing, landscape pattern of urban green spaces, analysis of the spatial boundaries of urban natural ecological zones, and determination of the importance of spatial regions by overlaying two different stratified analyses. This study proposes a methodological framework that can be integrated into efforts to identify ecological zones to increase the sustainability of urban ecology and green space quality. One potential limitation of the proposed methodology can be the lack of consensus and enthusiasm among the administrative actors regarding the issue. Therefore, it is recommended that the administrative bodies should be correctly informed by the relevant scholars and practitioners who are working on the subject.

KEYWORDS

urban green spaces; urban ecological zones; landscape ecology; landscape planning; green planning

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1. Introduction

One of the most significant factors for improving the sustainability and ecology of cities is urban green spaces. Urban green spaces (UGS) are defined as public or private green spaces which are located in the city and include many spaces such as green roads, sports-playgrounds, neighborhood and city parks, playgrounds, medians, afforestation areas (Lutz and Bastian, 2002; Niemela et al., 2010; Wolch et al., 2014).

UGS are important recreational areas for urban residents and have a strong ecological value (F. Li et al., 2005; Yenice, 2015). Green spaces that are located in the city such as gardens, recreational areas, medians, etc. should be integrated with the natural spaces in the city. As a result, natural balance and continuity are provided (Niemela et al., 2010; Swanwick et al., 2003). The management of UGS has gained increasing importance due to the increase in human population within living urban ecosystems (Lutz and Bastian, 2002; Niemela et al., 2010; Shafer; 1999; Shi, 2013; Swanwick et al., 2003; Wu and Loucks, 1995).

Although every green space is an urban space at the same time, it is stated that not every urban space can be considered a green space (Gül and Küçük, 2001; Schipperijn, 2010). To achieve urban sustainability goals, international studies mainly focus on man-made and built components of the urban environment (Lee and Kim, 2015). It is also important in terms of ensuring urban sustainability that active urban green spaces should be the green spaces to be evaluated in respect to quality (Breuste et al., 2008). It is a widely accepted view that quality green spaces increase the quality of urban life. Quality green spaces not only contribute to the mental and physical health, but also provide spaces for people to get away from the stress of modern life and breathe (Beer et al., 2001; Shi, 2013).

On the other hand, the city's natural spaces and the average percentage of UGS may be an important source for the restructuring of urban ecosystems and ecosystem-related functions (Bradley, 1995; F. Li et al., 2005; W. Li et al., 2015). The diversity of human activities in the city creates different habitats. Along with natural spaces, man-made habitats (such as garbage heaps, roadside, middle pavement, etc.) can also create rare spaces. However, it is a well-known fact that urban development is destroying urban biodiversity (Heikkinen et al., 2007; W. Li et al., 2005). The construction of ecological networks is an important way to improve the ecological aspect of open spaces in the city. Alternative ecological network scenarios can be created through analysis studies conducted for this purpose by using landscape structure indicators (Cook, 2002; Jim and Chen, 2003; Ong, 2003). Landscape ecology is also based on the principles of continuity and connectivity of natural landscapes as well as ecological elements (Mahmoud and El-Sayed, 2011). It is necessary to consider ecological information in urban planning to struggle against the negative effects of urbanization and to ensure urban sustainability (Flores et al., 1998). However, ecological data are ignored in urban management and planning in many underdeveloped countries. Urban parks, infrastructure, forestry, water and agriculture should be integrated. Urban green spaces, which are perceived concretely, form the open and green space system of the city when they are planned in a continuous sequence so that they reveal a functional structure in the city. At the same time, the continuity of the created system in time as well as in space serves ecological continuity (W. Li et al. 2005; Cook 2002; Wu 2014).

As for the study area, which is Aksaray province situated in the middle Anatolian region of Turkey, it has a plain structure surrounded by mountains and the Salt Lake. Its lowest point is 705 m and its highest point is 3275 m. It can be seen that most of the study area is at an altitude lower than 1276 m. For this reason, flat lands are in majority. Also, steppe vegetation dominates most of the study area, and aquatic, forest and rock vegetation types are also encountered, especially around dams, lakes and streams. Since the study area is located within the borders of Konya Closed Basin, it generally consists of plains. Due to its arid climate, there is a scarcity of water bodies. It can be seen that the largest water body in the study area is Salt Lake. It is known that the amount of green areas in Aksaray province has been decreasing from the past to the present.

This article aims to reveal the conceptual ecological framework and connectivity that supports the urban greening plan, which may be implemented even at regional and neighborhood scales for long-term urban sustainability, in an urban case study.

1.1. Urban green spaces

Table 1. Types of urban green spaces in England (Akyazı, 2019).

Type	Type of open space	Fitness for planning purpose and use in open space strategies	More detailed classification
Urban open space	Green space	Parks and gardens	Urban parks Country parks Formal gardens (including designed landscapes)
		Children and teenagers	Play areas (including LAPs, LEAPs and NEAPs) Skateboard parks Outdoor basketball goals Hanging out areas (including teenage shelters)
		Amenity greenspace	Informal recreation spaces Housing green spaces Domestic gardens Village greens Other incidental space
		Outdoor sports facilities	Tennis courts Bowling greens Sport pitches (including artificial surfaces) Golf courses Athletics tracks School playing fields Other institutional playing fields Other outdoor sports areas
		Allotments, community gardens and urban farms	Allotments Community gardens City (urban) farms
		Cemeteries and Churchyards	Churchyards Cemeteries
		Natural and seminatural urban greenspaces, including woodland or urban forestry	Woodland (coniferous, deciduous, mixed) and scrub Grassland (e.g., downland, meadow) Heath or moor Wetlands (e.g., marsh, fen) Open and running water Wastelands Bare rock habitats (e.g., cliffs, quarries, pits)
		Green corridors	River and canal banks Road and rail corridors Cycling routes within towns and cities Pedestrian paths within towns and cities Rights of way and permissive paths
	Civic space	Civic spaces	Sea fronts Civic squares Market squares Pedestrian streets Other hard surfaced pedestrian areas

In 2002, the Urban Green Spaces Taskforce in the UK adopted an urban green space definition that includes urban landscape elements such as streets, squares, plazas, sidewalks and boulevards. The UK Department for Transport defined urban green spaces as "areas consisting mainly of open, permeable and 'soft' areas such as soil, grass, shrubs and trees (Shi, 2008) (**Table 1**). Urban green space is also defined as "an integrated area comprising natural, semi-natural, or artificial green land, providing manifold benefits to different groups of people within the city extent" (Zhou and Rana, 2012). According to another definition, urban green spaces involve "all green spaces in urban areas, including forests, parks, private gardens, allotment gardens, cemeteries, brownfields, arable land, meadows and greenery along railway tracks, regardless of whether they are formally managed by the city, by their private owners or through any other arrangement" (Biernacka and Kronenberg, 2019).

UGS include all parks, playgrounds, and all other green spaces that are intended for recreational use (Swanwick et al. 2003; Mensah 2015). Parks, forests and agricultural lands are the three main types of urban green spaces with ecological, social and economic functions (W. Li et al., 2005).

It is understood that the UGS in the city have common features such as being in the city, being open to public access and being used for recreational purposes, as stated in many definitions. Urban green spaces are an important component of the urban ecosystem. Thus, they enhance the urban environment, help improve public health and improve the urban people's life quality (Lynn and Brown, 2003; F. Li et al., 2005; W. Li et al., 2005). The most important factor in the planning of UGS is to ensure the connectivity of green spaces in relation to landscape ecology (Jim and Chen, 2003; Bryant, 2006; Schipperijn, 2010).

1.2. Urban ecological zone

The concept of ecology, which was used for the first time by the German biologist Ernest Haeckel in 1866, examines the relationships of living things with their environments. Early ecologists defined ecology as "the branch of science which deals with organisms and the environment in which they exist" (McIntosh, 1985).

Pickett et al. (2011) stated that urban ecology is an integrated science which is based on ecology in general and focuses on urban ecosystems. Urban ecology is the scientific study of energy and material flows regarding the adaptation of plants and animals to the physical environment, interactions between living things and interactions between living things and the environment related to urban life (Rebele, 1994; Bilgili, 2009; Gaston, 2010). The terms "Ecosystem" and "Landscape Ecology" took place after urban ecology in 1935 and 1939, respectively (Wu, 2014).

With the rise of landscape ecology in recent years, the concept of landscape has gained an important status in the interdisciplinary literature. IALE (International Association for Landscape Ecology) defines landscape ecology as "a field of study in which changes in landscapes are examined at all scales and these changes include biophysical and social cause-effect relationships in the landscape" and states that it requires interdisciplinary cooperation. Landscape ecology focuses on issues such as spatial heterogeneity, the role of humans in creating and influencing the process of landscape patterns, landscape elements and the distribution pattern of the ecosystem (Wiens and Milne, 1989; Wu and Loucks, 1995; Pickett and Cadenasso, 1995; IALE Executive Committee, 1998; Mc Garigal, 2001). Evaluation of ecological network feasibility is done by analyzing the natural features of landscape elements, the relations between landscape elements and external factors that influence the functioning of the ecological network (Forman and Godron, 1986; Cook, 2002).

Green space continuity, which is constructed using the principles of landscape ecology, is important for urban planning (F. Li et al., 2005). Urban green spaces can be considered as similar to green tissue cells within the urban ecosystem network. For people who are responsible for preserving the existing natural and cultural landscape values of nature, a well-planned, and sustainable urban lifestyle which protects the ecological values is the only option (Gökalp and

Yazgan, 2013).

Ecological zones are defined as biogeographic land and water units characterized by different species and communities, according to the National Agricultural Library of US Department of Agriculture. It has been stated that ecological zones are regions that have similar characteristics in terms of climate, meteorological factors, topography, altitude, soil types (Ali Reza et al., 2002). On the other hand, it is emphasized that the boundaries of ecological zones cannot be drawn very clearly (Hillel, 2008, Ali Reza et al., 2002). According to Izeta (2010), ecological zones are landscape elements that combine interrelated animal and plant communities within a certain social context and environmental conditions, as part of an integrated system. The concept of ecological zone is associated with concepts such as ecotype, biome and niche, which are used in landscape ecology. The differences and relationships between the factors affecting the spatial distribution of urban ecological zones are summarized in **Table 2** according to the main literature examined.

Table 2. Primary criteria for ecological zones.

Primary criteria for ecological zones							
Studies	**Topographical structure**	**Geological structure**	**Climate**	**Land use**	**Hydrologic structure**	**Flora**	**Fauna**
Gusarov (2021)			✓		✓	✓	
Ali Reza et al. (2002)	✓	✓	✓			✓	✓
Schultz (2005)	✓	✓		✓	✓		
Unninayar and Olsen (2008)			✓			✓	✓
Hillel (2008)	✓	✓	✓	✓			
Izeta (2010)	✓					✓	✓
Ringrose et al. (1988)				✓	✓	✓	

2. Methodology

2.1. Study area

Aksaray province (central district and other districts) has been chosen as the study area. It is located between 33º-35' east meridians and 37º-38' north parallels. Its area is 7626 km². Aksaray has 7 districts, 192 villages and towns, namely Ağaçören, Eskil, Gülağaç, Güzelyurt, Ortaköy, Sarıyahşi and Sultanhanı (Akyazı, 2019).

In the study area, apart from five big city parks, there are squares, forest areas, agricultural areas, residential gardens, schools, cemeteries and historical, cultural, natural and tourism areas. Especially old-dated residential buildings have their own landscaping (Eskin and Doğanay, 2019). Önder and Akbulut (2011) and Yenice (2015) found that 4 out of 41 neighborhoods in the city center are in very good condition in terms of urban green space, while the green spaces of the other 37 neighborhoods are far below the standards. It is seen that 86% of the green pattern surrounding the city is outside the city center in terms of accessibility criteria. 20.75% of neighborhood parks are under 0.1 ha, 33.96% parks are between 0.1–0.2 ha, 24.53% parks are between 0.2–0.4 ha and 20.75 % parks are between 0.40–0.60 ha (Yenice, 2015).

The ones used as database in the study; (1) The spatial distribution data of the urban green spaces digitized in ArcGIS 10.1 from the 1/5000–1/1000 scaled zoning plans obtained from the central and district municipalities in the research area, (2) Land use class data obtained from the Geology Department of Aksaray University, (3) Hydrology, morphology and DEM data obtained from the Geology Department of Aksaray University and digitized in ArcGIS 10.1.

2.2. Study design

In this study, a study design has been created to improve the urban ecological infrastructure and to associate the green space network with the ecological zones. This design is divided into four parts; 1) Data processing, 2) Landscape pattern of urban green spaces, 3) Analysis of the spatial boundaries of urban natural ecological zones, and 4) Determination of the importance of spatial regions by overlaying two different stratified analyses. First of all, the existing urban green spaces with functions such as parks and gardens, social activity areas, sports fields, public farms, natural and semi-natural urban green spaces, wooded lands have been inventoried and mapped in the province of Aksaray. Then, Aksaray central and district municipalities were contacted and zoning plans were requested from the relevant units. Zoning plans of all districts of Aksaray province, including the central district, except Güzelyurt district, have been obtained. From these development plans, the green areas within the scope of the study were determined and first subjected to digitization on a district basis. These green areas, which were then digitized, were combined to create integrity. The digitized data were overlaid with green areas in the ArcGIS 10.1 software as ecological zone criteria.

The study design has been based on two approaches, namely the ecological network analysis approach that provides the connection of urban artificial and natural spaces in the study of Li et al. (2015) and the urban green space plan based on ecological principles and landscape ecology approaches used to ensure continuity in the study of F. Li et al. (2005).

As the ecological zone criteria which are defined by literature research and given in **Table 2**; vegetation (agricultural areas, natural meadows, broad-leaved forests, pastures), hydrological structure, land use status and climate have been discussed.

Thus, urban ecological zones have been created spatially. The climate structure has been accepted as the same for the whole city. The stratification method used by Ian Mc Harg in the natural features inventory and the overlapping method in associating the layers has been adapted and applied for the definition of ecological zones to associate the created urban ecological zones with urban green spaces. In addition, with overlay analysis, the datasets have been combined with maps are divided into four datasets in ArcGIS 10.1, consisting of several layers for each dataset, and their importance degrees have been created.

Through this method, which overlaps with the basis of continuity and connectivity in landscape ecology, layers have been overlapped and areas with high ecological potential and areas with low ecological potential have been determined. Recommendations have been developed to increase the quality of urban green space and to contribute to the city management in terms of natural life sustainability. This study proposes a methodological framework that can be integrated into efforts to identify ecological zones to increase the sustainability of urban ecology and green space quality (**Figure 1**). Identified ecological zones are also protection and balance zones in dense urban development.

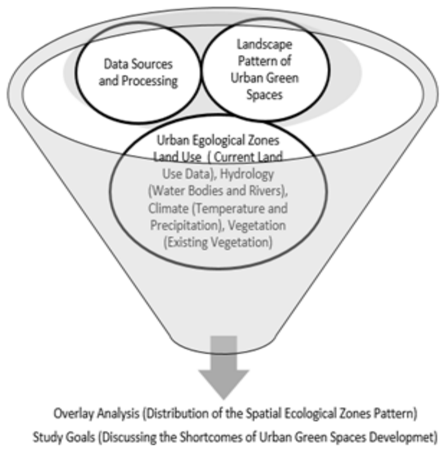

Figure 1. Maps and datasets used in study design.

3. Results

3.1. Urban green space structure of the study area

In general, it is observed that the functionality of UGS has decreased over time due to reasons such as the insufficient amount in cities and their independence from each other, construction, etc. The amount of urban green space of Aksaray province, which has been chosen as the study area, has been digitized in ArcGIS 10 (**Figure 2**).

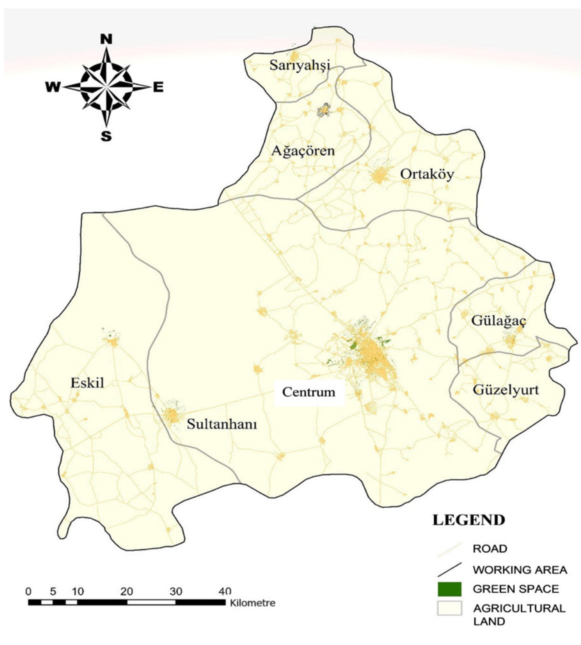

Figure 2. Map of Urban Green Spaces in Aksaray.

It has been calculated that the total amount of urban green space in the study is 17,178.170 m^2. The amount of urban green space includes the area to be afforested, the refuge, the recreation area, the playground and the municipal nursery according to the zoning plans. It is seen that the spaces with the highest amount in this classification are the parking areas (13,354.321 m^2) in total. This is followed by afforestation (1825.419 m^2), recreation areas (1901.184 m^2), refuges (22,285 m^2), municipal nursery (11,661 m^2) and children's gardens (63.3 m^2). When the total amount of UGS is compared according to the districts, it is seen that the highest amount of UGS (12,626.430 m^2) is in the central district. The amount of UGS by districts is given in **Table 3**. The amount of urban green space per capita in the city is less than 10 m^2 according to official data.

Table 3. The amount of urban green spaces by districts.

	Parks (m^2)	Afforested area (m^2)	Refuge (m^2)	Recreation (m^2)	Playground (m^2)	Municipal nursery (m^2)	Total (m^2)
Center	9598.870	1145.779	-	1881.781	-	-	12,626.430
Ağaçören	488.324	137.439	15.182	-	-	-	640.945
Eskil	253.436	318.010	7.103	19.403	63.3	-	661.252
Gülağaç	799.105	16.373	-	-	-	11.661	827.139
Ortaköy	422.006	15.653	-	-	-	-	437.659
Sarıyahşi	557.534	-	-	-	-	-	557.534
Sultanhanı	1235.046	192.165	-	-	-	-	1427.211

All results indicate that the UGS of the city of Aksaray are far behind the ideal criteria in terms of spatial size. In addition, the comparative amount of UGS between the years 1986–2022 has been produced from the Landsat satellite images and mapped (**Figure 3**). Measures were those that used satellite derived indices, such as the normalized difference vegetation index (NDVI) or land use datasets to estimate the coverage of natural areas within a geographic area or overall "greenness" of an area. According to Figure 3, while the amount of urban green space was 1700.458 km^2 in 1986, it is 1187.086 km^2 in 2022. There is a decrease in the amount of green spaces.

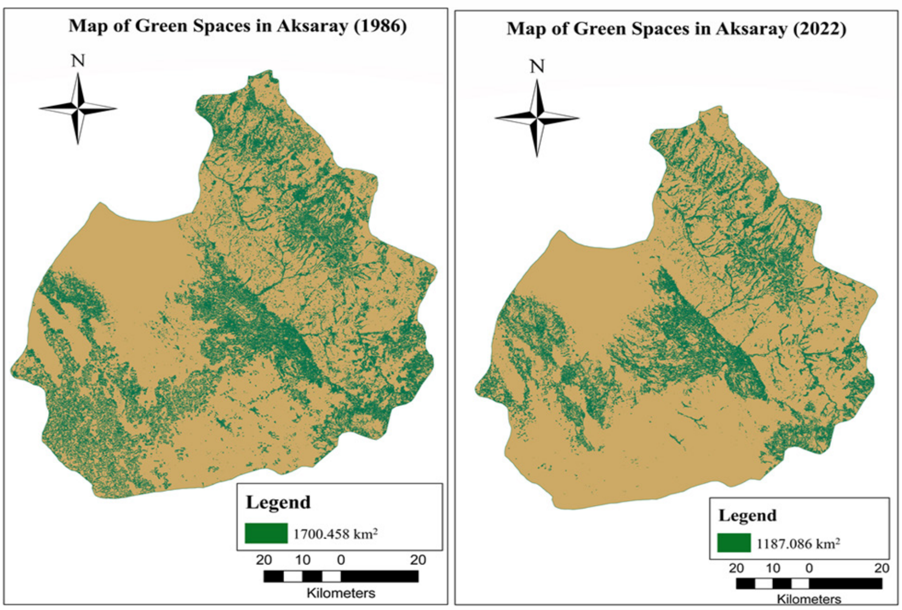

Figure 3. The comparative amount of between the years 1986–2022.

3.2. Urban ecological structure of the study area

It is seen that the amount of groundwater is high in places rich in forest existence in Aksaray. The forest area of Aksaray constitutes 2.78% of the total area (1.72% natural + 1.06% afforestation) (Akyazı, 2019). Steppe vegetation is dominant in most of the study area, and aquatic, forest and rock vegetation types are also encountered, especially at the edges of dams, lakes and streams (Kiraz and Tekşen, 2014).

There are Salt Lake, Höşür Stream, Köşkerliözü Stream, Küçükhortu Stream, Melendiz Stream, Balcı Pond, Hirfanlı Dam, Kültepe Dam, Mamasın Dam, Çetin Pond, Kızılırmak River, Acıgöl, Akgöl, Ağgöl and Küçükgöl within the boundaries of the study area. Since the study area is located within the boundaries of Konya Closed Basin, it generally consists of plains. The land use with the largest area has been determined as non-irrigated arable lands (3751.19 km^2). Due to its arid climate, the scarcity of water bodies is striking. It is seen that the largest water body in the study area is Salt Lake.

Although there is a density of construction in and around the center, a discontinuous urban structure can be seen as one moves away from the center. There are privately owned orchards and broad-leaved forests mostly around the shores of streams, dams and ponds. The land use map suggests that the study area consists of constantly irrigated areas, water bodies, bare rocks, natural meadows. Ecologically important natural areas are water bodies, natural meadows, sparse vegetation areas, pastures, swamps, broad-leaved forests, agricultural areas with natural vegetation (Aksaray Province Environmental Status Report, 2017).

Incorporating ecological information into urban green space system planning and management is positive for urban ecosystems and associated species. Urban ecological networks are core areas protected by buffer zones or interconnected by ecological corridors (Jongman and Pungetti, 2004). In terms of the functions of urban green spaces, hydrogeological data is important because of the lithology of the soil, the amount of water in the soil and the mass water cycle. Based on the principles of landscape ecology, vegetation data has been used in terms of the necessity of connecting these areas, which are specialized in urban ecology, with an urban green pattern. As an ecological zone criteria explained in the Method section and compiled from the literature land use, hydrology and vegetation maps have been created (**Figure 4**).

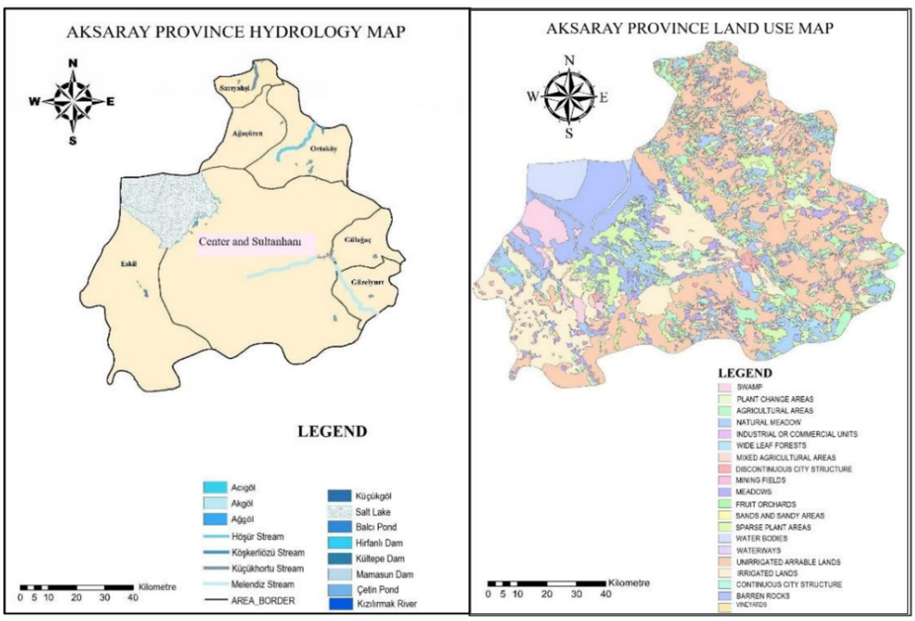

Figure 4. Land use, hydrology and vegetation maps.

Land uses, hydrology and vegetation, which are considered as ecological zoning criteria, analyzed by Ian Mc Harg's natural stratification (Overlay) method and an ecological zoning map has been created (**Figure 5**).

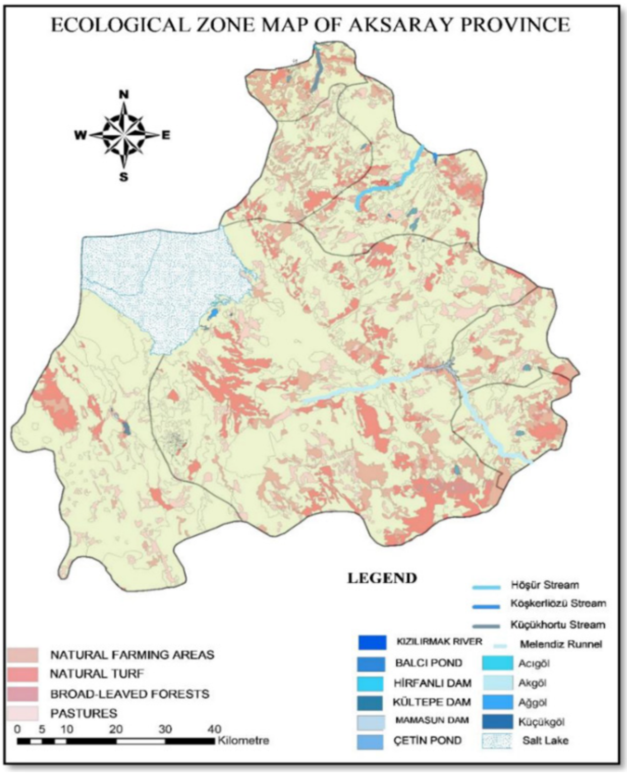

Figure 5. Ecological zone map of Aksaray.

3.3. Association between urban green spaces and ecological zone of the study area

Aksaray province has gained a rapid modernization process especially since 2008, and the city, known as "Green Aksaray" in the past, is filled with concrete structures and pollution has increased. Due to the increasing construction and concretization, Aksaray province has lost green spaces and lost its natural texture in the rapid urbanization process (Bharne, 2013). Forman (1995) states that an urban green space system which has ecological integrity has almost all natural requirements for productivity, biodiversity, soil and water. In accordance with this proposition, in the study of Aksaray province, the relationship between UGS and ecological zones has been revealed and their importance levels have been established in terms of ecological integrity (**Table 4**).

Table 4. Criteria.

Degree of importance	Ecological zone criteria
1st level of importance	• Urban green space • Hydrology • Land use
2nd level of importance	• Urban green space and hydrology • Hydrology and land use • Urban green space and land use
3rd level of importance	• Only land use

Besides, datasets regarding these importance levels have been combined with maps created by overlay analysis and divided into four datasets in GIS and consisting of several layers for each dataset (**Figure 5**). According to the Aksaray city zoning plan, the UGS are in the central form and surround the residential areas as mosaics. Currently, there is no green belt surrounding the city. Therefore, the green structure is formed by a combination of linear and non-linear elements at the scale of the city and neighborhood as seen in Figure 2. Although the amount of urban green space per capita is (7.8 m^2) according to official sources, there are also non-public places within the indicator. These spaces are not evenly distributed and up to a certain extent isolated as well. So as to protect the urban ecological balance and to support the development of urban green spaces with high biological reserve quality, the urban green space management model has been constructed in the urban context as follows, using the method of theory building together with the results of the analyses (**Figure 6**).

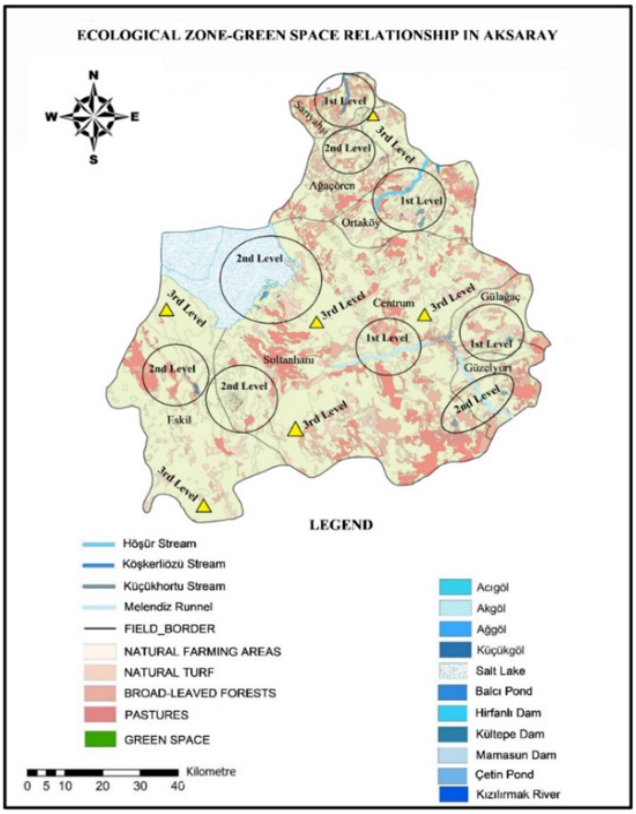

Figure 6. Map of ecological zones-urban green spaces relationship.

Spaces with 1st level of importance: It has a high level of importance in terms of ecological potential. This is because in these areas, although these spaces involve land use and vegetation diversity, they have hydrological richness as well. They are areas with first class and second-class soil structure and also natural vegetation. These areas, which involve pasture areas, natural meadows and forest assets, also have high hydrological value and can be seen in the **Figure 4**. These areas not only enrich the biodiversity of green areas, but are also urban natural reserves.

Spaces with 2nd level of importance: These are spaces which involve the ecological zone criteria of land use-green space, land use-hydrology or green space-hydrology. The difference of these spaces from the spaces with 1st level of importance is that they contain only 2 of the 3 criteria. In other words, one of the criteria cannot be met. Spaces with 2nd level of importance are less functional compared to those of 1st level of importance. Furthermore, the lack of any of the relevant criteria in these spaces shows a weaker character in terms of urban green infrastructure formation and sustainability.

Spaces with 3rd level of importance: These are spaces that do not meet any of the relevant ecological zone criteria. In other words, all areas other than the spaces with 1st and 2nd level of importance have been considered as spaces with 3rd level of importance in the study area. These areas are; swamps, industrial and commercial units, mixed agricultural areas, discontinuous urban structures, mining areas, sandy areas, sparse vegetation areas, non-irrigated arable land, bare rocks, vineyards.

It has been concluded that the relationship between spatial inequality of green areas (including urban green space and ecosystem services) and population and city size is not sufficient. Besides, the results suggested that a significant portion of the surrounding areas around the city are suitable for the expansion of UGS outside the city borders. Existing rivers in the city of Aksaray can also provide an opportunity to develop greenways successfully. The analyses provided the ability to compare and relate two different structures within the urban development. The spatial spread of the detected ecological zones guides to increase the sustainability of the urban ecology and their importance levels to ensure ecosystem diversity.

4. Discussion

Aksaray province is considered as a typical example of urbanization in the arid and saline regions of Central Anatolia since the city is at the beginning of the urbanization process and has a unique geographical location and a significant potential for development. In these respects, the construction of suitable ecological infrastructure and urban green space texture is of utmost importance.

In this study, a proposal that can direct the multi-faceted development has been formulated, especially by analyzing the urban green space pattern and evaluating the land uses with high naturalness capacity in the city. The protection zones determined at the city scale are important as a part of the green infrastructure in strengthening the ecological structure of the city. The implementation of this relational plan based on GIS is a practical tool for the development of urban green spaces and ensuring the continuity of urban biodiversity. For the purpose of the study, urban sustainability is defined as a process that facilitates and maintains a balanced cycle between ecosystem and human well-being through economic, social and ecological actions in reaction to changes inside and outside the urban landscape (Niemalä, 2014).

Urbanization is a threat to many natural habitats and species. Ecological knowledge should be taken into account in urban planning to counter the negative effects of urbanization and to ensure urban sustainability. With its connectivity and continuity from the landscape ecology, the existing landscape mosaic of the Aksaray urban region has a series of open space elements of changing ecological nature (Akyazı, 2019).

Based on the principles of landscape ecology, this method focuses on the relationship between patterns of urbanization and ecological processes (Wu, 2014). Landscape ecology provides an insight into how spatial patterns influence ecological processes. It provides a theoretical foundation for landscape and urban planning for patches, corridors and matrix, which are suggested as the three basic component types of any landscape (F. Li et al., 2005). Since the stability of habitat quality will change with climate change, urban natural species will be in search of new and better habitats (EU Communication for the Commission 'Green Infrastructure

(GI)—Enhancing Europe's Natural Capital', 2013), Due to the effectiveness of the ecological corridors and spots to penetrate the landscape and provide connectivity (Forman, 1986), the combination of natural ecological zones and urban green space land mosaic in the city should be built with a protection-use balance within the city administration. It is possible to say that the structure of the small, fragmented and dispersed green area contains some negativities such as insufficient plant tissue, inability to allow the development of wildlife, and insufficient microclimate effect (Wilbers et al., 2022).

The association between urban green space and ecological zone emphasized in the study does not show the inequality between urban development and the change in the amount of urban green space per population. To understand the change in inequality with urban development, future research that can observe the change in the spatial inequality of UGS in a city over time is needed.

The planning and distribution of UGS becomes a very important issue in cities with limited land resources and high density of construction. However, many studies have proven that not only the urban green space distribution, but also the spatial configuration of the green space plays an important role in achieving ecological benefits. Wilbers et al evaluated the benefits and costs of blue–green investments for a peri-urban sub-catchment in Oslo, Norway. They reported that the investments made in BGI can be evaluated positively in socio-economic terms (Wilbers et al., 2022).

The best protection and development of urban green spaces and natural spaces in the region is a component which we have focused on to manage the ecological fabric of the city Along with the disappearance of the ecological structure in the urban development processes, the increase in artificial green land can also create new ecological cradles in the city. At the same time, an ecological network can have a positive impact on the resources surrounding the urban space. This study argues that a significant ecological improvement can be accomplished by planning a strategy for urban green space systems that adopt the ecological network concept. Green corridors and green wedges that come from the fundamentals of landscape ecology are also ecological zones with high natural quality in the city. Integrated urban green space systems that connect the city periphery and inner regional areas are integrative and supportive of ecosystem functioning. While making zoning plans in the developing Aksaray province, especially ecological zones should be considered and these spaces should be protected. While designing the UGS in the zoning islands, the necessity of these areas to be interconnected should be taken into consideration. Considering that Aksaray province and its surroundings are in the basin status, it is recommended to make a detailed "Aksaray Province Urban Ecological Plan", which takes into account the entire urban and ecological structure, by carrying out planning work in the study area.

With monitoring studies, it may be considered to analyze the spatial and temporal dynamics of the landscape pattern and to combine the interconnectedness scale with ecological zones. According to the evolution of Ecological Zone indicators, the relationship between laws and policies related to the development of the green area system, current problems and solution strategies can be discussed.

Sustainability is a social issue apart from its economic dimension. Cope et al. (2022) discussed the concept of sustainability from a social perspective, stating that people who feel connected to and satisfied with their communities have a more positive relationship with the natural environment than those who are dissatisfied with their communities. Accordingly, they underlined the importance of the contribution of individuals and social sustainability for environmental sustainability. Therefore, future research should be designed to address the non-physical social dimensions of sustainability (Cope et al., 2022).

5. Conclusion

Ensuring the sustainability of first-degree ecological zones is important because of the ecological character structure they contain. It is proposed to be a core zone for conservation and associated UGS within the green infrastructure. The amount of UGS should be increased in the 2nd degree important lands, especially in the areas lacking green areas, taking into account the relationship with the natural structure. On the 3rd degree lands, arrangements should be made by focusing on natural vegetation and the amount of urban green space should be increased.

The creation of urban green corridors and the combination of these corridors and ecological zones based on landscape ecology in terms of urban green space connection form the basis for green infrastructure. The important water assets in the ecological zone areas identified in Aksaray city and the linear feature of the Ulu River provide connectivity potential. Finally; with this proposed urban green space planning, an improved contact with nature is ensured, the function of ecological resources at different levels is improved, the landscape pattern is optimized, and a green infrastructure model proposal that meets the requirements of Aksaray province is built.

Author contributions

Conceptualization, ÜBH; methodology, ÜBH; software, AN; validation, ÜBH and AN; formal analysis, ÜBH; resources, ÜBH; writing—original draft preparation, AN; writing—review and editing, ÜBH; visualization, AN; supervision, ÜBH. All authors have read and agreed to the published version of the manuscript.

Conflict of interest

No conflict of interest was reported by all authors.

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