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Analysing the Land Use Alteration's Impact in the District of Belen (Hatay) on the Natural and Built Environment by using Corine Data

Zehra Tugba Guzel*, [a], Elif Bozdogan Sert[b]

[a] *Department of Landscape Architecture, Faculty of Architecture, Iskenderun Technical University, Iskenderun-Hatay, Turkey*
e-mail: ztugba.guzel@iste.edu.tr
ORCID ID: 0000-0002-6450-8204
[b] *Department of Landscape Architecture, Faculty of Architecture, Iskenderun Technical University, Iskenderun-Hatay, Turkey*
e-mail: elif.bozdogansert@iste.edu.tr
ORCID ID: 0000-0002-4812-2360

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Corresponding Author:
E-mail: ztugba.guzel@iste.edu.tr

ABSTRACT

Pieces of land around the world have been physiologically affected by the changes that have occurred to meet basic needs such as industry, transportation, and settlement since ancient times. These changes also reveal differences in land cover. Land classes concerning nature can be evaluated in four categories: built areas, green areas, semi-natural areas, and natural areas. This study was carried out to reveal the change over time in the existing land use classes of Belen district of Hatay, located in the south of the Eastern Mediterranean. Belen has been chosen as the study area due to its strategic importance for the economy of the city and its diversity in terms of land classification. The study was carried out in 3 stages. In the first stage, the related literature was reviewed; studies on land classes of other cities by using CORINE data were brought together. In the second stage, the spatio-temporal change of the land use classes of Belen district between 1990-2018 was revealed by the analysis of the CORINE Land Cover (CLC) data. Thus, Belen's land use classes were evaluated under the titles of "Built Areas, Agricultural Areas, Natural Areas, Wetlands, and Water Bodies"; quantitative-qualitative data are presented within the scope of urban fabric, agricultural structure/forest existence, and changes in protected areas. In the third stage, all data were evaluated and recommendation were made regarding the alteration's effects in the field over the course of 28 years on the natural and built environment. As a result of the study, it has been observed that the changes in the district of Belen are particularly important for the persistence of the biodiversity/ecological balance on the natural and protected areas. For this reason, in future decisions to be made for the urban, importance should be given to the conservation of agricultural areas, stabilization of natural-semi natural area, and the cooperation of local administrations and public institutions with the experts of the subject to ensure the sustainability of the protected areas.

Anahtar Kelimeler:
Arazi örtü sınıfları
Yapılı çevre,
Doğal çevre,
CORINE.

ÖZ

Dünya üzerindeki arazi parçaları antik çağlardan bugüne sanayi, ulaşım, yerleşim gibi temel ihtiyaçların karşılanması amacıyla ortaya çıkan değişimlerden fizyolojik olarak etkilenmiştir. Bu değişimler arazi örtüsünde de farklılıklar ortaya çıkarmaktadır. Doğa ile ilişkili olarak arazi sınıfları yapılı alanlar, yeşil alanlar, yarı-doğal alanlar ve doğal alanlar olmak üzere dört kategoride değerlendirilebilmektedir. Bu çalışma Doğu Akdeniz'in en güneyinde yer alan Hatay'ın Belen ilçesinin mevcut alan kullanım sınıflarının zaman içerisindeki değişimini ortaya koymak amacıyla yapılmıştır. Belen, kentin ekonomisi için stratejik öneme sahip olması ve arazi sınıflandırması açısından çeşitlilik göstermesi nedeniyle çalışma alanı olarak seçilmiştir. Çalışma 3 aşamalı olarak yürütülmüştür. İlk aşamada konu ile ilgili literatür taranmış; CORINE verileri kullanılarak diğer

kentlerin arazi sınıflarına yönelik yapılan yapılan çalışmalar bir araya getirilmiştir. İkinci aşamada Belen ilçesinin 1990-2018 yılları arasındaki arazi sınıflarının zamansal-mekansal değişimi CORINE Land Cover (CLC) verilerinin analizi ile ortaya konmuştur. Böylece, Belen'in arazi sınıfları "Yapılı Alanlar, Tarım Alanları, Doğal Alanlar, Islak Alanlar ve Su Kaynakları" başlıkları altında değerlendirilmiş; kent dokusu, tarımsal yapı/orman varlığı ve korunan alanlardaki değişimler kapsamında nicel-nitel veriler sunulmuştur. Üçüncü aşamada ise elde edilen tüm veriler ile alandaki 28 yıllık süreçteki değişimin doğal ve yapılı çevre üzerindeki etkileri değerlendirilerek öneriler sunulmuştur. Çalışma sonucunda Belen ilçesinde yaşanan değişimlerin özellikle doğal ve korunan alanların biyoçeşitlilik/ekolojik dengesinin devamlılığı açısından önemli olduğu görülmüştür. Bu nedenle kentin gelecekteki büyümesine yönelik alınacak kararlarda tarımsal alanların korunması, doğal-yarı doğal alan örtüsünün stabilizasyonu ve korunan alanların sürdürülebilirliğinin sağlanması noktasında yerel yönetimler ve kamu kurumları konunun uzmanları ile birlikte hareket etmesi hususuna önem verilmelidir.

1. Introduction

Considering the change in the world from ancient times until today, land plots are areas open to physiological change. However, this change may be due to time or may result from factors that trigger the change. Monitoring the size and causes of the change has become important for the protection of environmental balance and the persistence of natural systems. Complex structures related to nature are defined in four main categories as natural systems, built-up areas, green areas, semi-natural areas, and natural areas. Buildings and their immediate surroundings define built-up areas, areas reserved for recreational use, green areas, regions with ecological balance exposed to human influence, semi-natural areas, and regions that have not been subjected to any intervention and preserve their ecological balance define natural areas. [1-10]. It is known that the feature that separates natural areas and built areas from each other is the effect of interventions in the natural process. External interventions that may occur outside of the changes due to the temporal process led to the change of the covering the land, leading to the definition of the concept of land cover [11-18]. The first people made changes in natural areas such as agricultural lands, forests, and pastures in a way to continue their lives, and made the beginning of external interventions. In today's conditions, the acceleration of urban development with the increase of population [19-22], increasing life expectancy [23-26], consumption rates [27-29], and technological developments in various fields [30-32] have led to a complete change in the use case. These changes, which take place to meet basic needs such as industry, transportation, and settlement, are experienced in every region of the world. As a global phenomenon, the change in land cover affects all entities such as people [33-36].

Feranec et al. [37] put forward the countries with the highest/lowest change in their study, where they determined the land cover classification of European cities between 1990 and 2000. As a result of the research, while the country with the highest rate of urbanization is the Netherlands; It has been determined that the natural and built environment in Slovenia has experienced the least change. Conservation and enhancement of the Czech Republic and Irish farmland; Portugal supports practices within the scope of deforestation and afforestation works and increasing natural areas. Kucsicsa et al. [38] found that Romania's land cover changed in the direction of the increase in the built environment. They determined that this situation will cause the separation of landscape areas, the destruction of biodiversity, and the occurrence of natural disasters, which will negatively affect the ecological structure. Martínez-Fernández et al. [39] determined in their studies that there were land changes in agricultural lands, natural and semi-natural areas of Spain between 1985-2012. As a result of the study, the change of land cover classes included in natural systems for various reasons emerged as a global problem; On the other hand, it seems possible that cities can eliminate change with the approaches they follow. It is observed that land uses have changed in many urban examples in our country, depending on the external factors that occur as a result of human activities. According to the research data of the European Environment Agency, 25,000 hectares of agricultural land, 37,000 hectares of semi-natural land, and 55,000 pastures have been destroyed in Turkey. It is observed that agricultural lands are negatively affected especially within the land use classes [40,41]. This issue is also taken into account in our country in terms of urban planning to preserve the current state of land uses and to minimize their changes. Kaya and Gorgun [42] analyzed the transformation of agricultural areas close to residential areas, transportation axis, and industrial areas into built areas in their study in the Balıkesir-Bandırma region. Ikiel et al. [43] found that the Mugla-Datca coastal city, which is not suitable for settlement due to its rugged land, has decreased agricultural areas, semi-natural areas, and forest areas due to its commercial structure due to agricultural production and tourism opportunities. Sonmez et al. [44], in their study in Antalya-Kemer, stated that the area of urban use due to tourism and secondary housing use in the region has increased; and decreases in the number of beaches, dunes,

and agricultural lands. Detecting the change of land cover ensures the protection of productive natural areas, the controlled growth of the built environment, and the progress of the economy of the region [45].

This study aims to reveal the change and the reasons for Belen's existing land use classes over time. The obtained data for this purpose are evaluated within the scope of built areas, agricultural lands, natural and semi-natural areas. The study results are aimed to guide the decisions to be taken on Belen's urban development.

2. Material and Method

The study area is the Belen district of Hatay, located in the southernmost of the Eastern Mediterranean (Figure 1). Constituting Hatay's commercial axis, Belen has strategic importance for the city's economy. At the same time, it was chosen as a study area due to its diversity in terms of land classification. Belen is the only region where the Amanos Mountains pass through, enabling road transport between the Middle East and Europe from the Ottoman period to the present. Belen's proximity to the sea also provides access to the sea transportation of the existing highway [46]. The diversity of the land use classes of the district increases its ecological value due to its natural vegetation, fertile soils, protected areas (Belen Nature Park), and climate characteristics. This situation directs urban development; The high growth potential makes natural areas and agricultural lands open to external intervention. Especially the fact that the route called "Belen Gecidi" kept the economic structure of the city alive caused the development of the region over time [47].

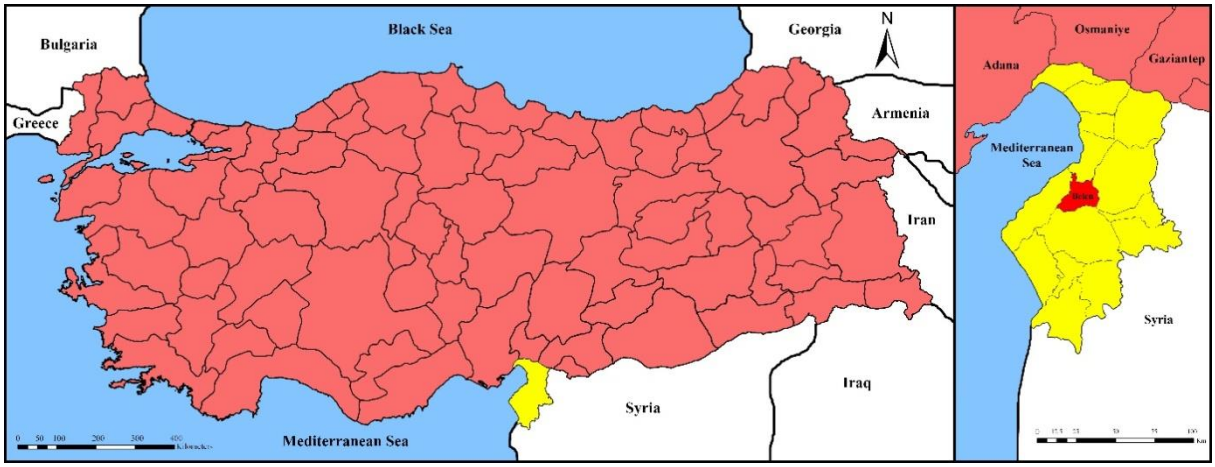

Figure 1. Study area

The study, which was carried out to determine the effect of the change in the use of the area on the natural and built environment, reveals the spatio-temporal change of Belen district between 1990-2018 with the analysis of the CORINE Land Cover (CLC) data [48]. In this context, the study was carried out in 3 stages. In the first stage, the literature was reviewed; studies using CORINE data have been brought together. In the second stage, the Civil and Administrative Boundaries of Belen district, which is of ecological, economic, and cultural importance, were determined and intersected with the CORINE maps for 1990, 2000, 2012, and 2018 in the ArcGIS 10.5.1 software program. At this stage, land classes have been revealed using Corine data. Thus, the quantitative-qualitative data of Belen on "Built Areas, Agricultural Areas, Natural Areas, Wetlands, and Water Bodies" were obtained (Table 1). Since there is no wetland within the scope of the district, the results have been evaluated under the headings of built areas, agricultural areas, and natural areas; The scope of these titles are determined as urban texture, agricultural structure/forest property, and protected areas. Numerical data on all field uses are presented. In the last stage, the effects of the change in the field on the natural and built environment were evaluated with all the data obtained; recommendations are made.

Table 1. CORINE land cover classes

Level 1	**Level 2**		**Level 3**	
1.Artificial surfaces	1.1	Urban Fabric	1.1.1	Continuous urban fabric
			1.1.2	Discontinuous urban fabric
	1.2	Industrial, commercial and transport units	1.2.1	Industrial or commercial units
			1.2.2	Road and rail networks and associated land
			1.2.3	Port areas
			1.2.4	Airports
	1.3	Mine, dump and construction sites	1.3.1	Mineral extraction sites
			1.3.2	Dump sites
			1.3.3	Construction sites
	1.4	Artificial, non-agricultural vegetated areas	1.4.1	Green urban areas
			1.4.2	Sport and leisure facilities
2. Agricultural areas	2.1	Arable land	2.1.1	Non-irrigated arable land
			2.1.2	Permanently irrigated land
			2.1.3	Rice fields
	2.2	Permanent crops	2.2.1	Vineyards
			2.2.2	Fruit trees and berry plantations
			2.2.3	Olive groves
	2.3	Pastures	2.3.1	Pastures
	2.4	Heterogeneous agricultural areas	2.4.1	Annual crops associated with permanent crops
			2.4.2	Complex cultivation patterns
			2.4.3	Land principally occupied by agriculture, with significant areas of natural vegetation
			2.4.4	Agro-forestry areas
3. Forests and semi-natural areas	3.1	Forests	3.1.1	Broad-leaved forest
			3.1.2	Coniferous forest
			3.1.3	Mixed forest
	3.2	Shrub and/or herbaceous vegetation associations	3.2.1	Natural grassland
			3.2.2	Moors and heathland
			3.2.3	Sclerophyllous vegetation
			3.2.4	Transitional woodland shrub
	3.3	Open spaces with little or no vegetation	3.3.1	Beaches, dunes and sand plains
			3.3.2	Bare rocks
			3.3.3	Sparsely vegetated areas
			3.3.4	Burnt areas
			3.3.5	Glaciers and perpetual snow
4. Wetlands	4.1	Inland wetlands	4.1.1	Inland marshes
			4.1.2	Peat bogs
	4.2	Coastal wetlands	4.2.1	Salt marshes
			4.2.2	Salines
			4.2.3	Intertidal flats
5.Water bodies	5.1	Inland waters	5.1.1	Water courses
			5.1.2	Water bodies
	5.2	Marine waters	5.2.1	Coastal lagoons
			5.2.2	Estuaries
			5.2.3	Sea and ocean

3. Result and Discussion

In the study, which was carried out to determine the effect of the change in the land use of Belen district on the natural and built environment, and in which the spatio-temporal change between 1990-2018 was revealed by using the CORINE Land Cover (CLC) data; all data were evaluated by years. According to the obtained data, the changes are presented as maps in Figure 2 and Figure 3; Quantitative data are presented in Table 2 and Table 3.

When the changes in land cover between the years 1990-2000 are evaluated, it is seen that the built environment has spread towards the forest areas in the northwest of the region and on the connecting roads between the residential areas and neighboring districts. The growth in residential areas (24,94 ha) shows that the city is preferred as a living space. Current progress in terms of transportation and settlement will indicate that the natural and built areas of the region will undergo a spatial change in the future. The economic growth of Belen draws attention in terms of agricultural production activities as well as its contribution to the transportation network on a regional scale. Agricultural production is mainly carried out in the form of irrigated and dry field agriculture. However, its status in the product type and existing area classification has changed minimally. Accordingly, these areas, which have turned into vineyards and garden agriculture, are located both in the vicinity of the residential areas and in the east and southwest of the region. The spatial changes that occurred in the land cover classification occurred mostly in natural and semi-natural areas. When evaluated in terms of forest areas; it was determined that coniferous forests (217,65 ha) and mixed forests (767,68 ha) experienced regional area loss, while broadleaf forests (166,67 ha) increased really. In this context, while there is an increase in the land cover in the form of bushes in the northern parts of the region; there is an increase in the number of broadleaf forests in the southern parts of the region. The reasons for the change between the number of plants in bush form and forest lands can be explained as the development or drying of the natural vegetation. However, anthropogenic effects (forestry activities, agricultural land acquisition, etc.) are also considered to be involved in the process. The transformation of forest areas into shrubs (944,66 ha) occurs with the mass change of land plots and the inclusion of burning areas (49,87 ha) in forest land. Besides, there are natural meadows (1.019,37 ha) and areas covered with sparse vegetation (110,52 ha) in the northern parts of the region. The existence of these areas can be associated with the livestock activities that constitute the agricultural production structure of the district.

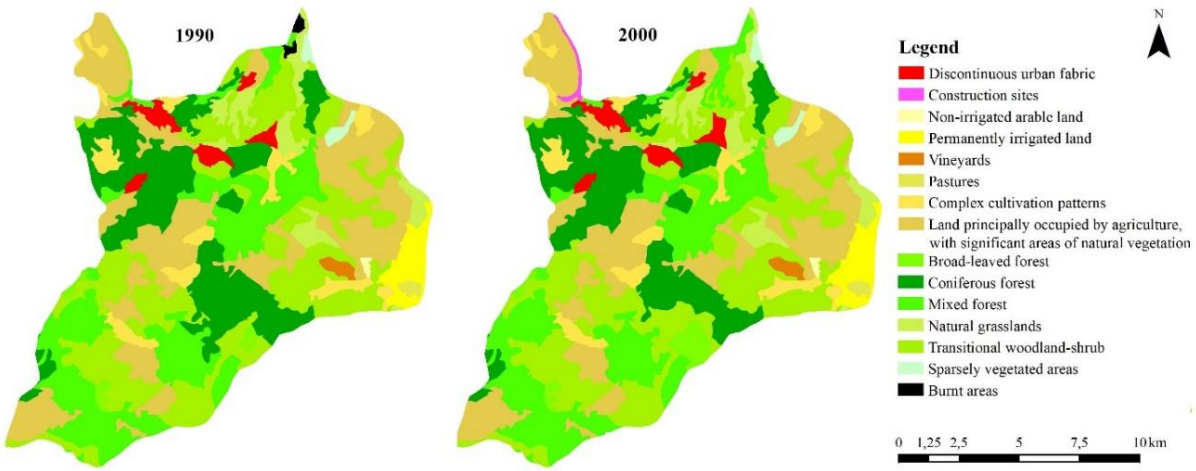

Figure 2. The Change in the Land Use of Belen Between 1990-2000.

Table 2. Numerical Data on Change in Land Use.

	1990	2000	2012	2018
112: Discontinuous urban fabric	368,11	393,04	560,10	560,10
121: Industrial or commercial units	-	-	174,76	184,41
122: Road and rail networks and associated land	-	-	35,10	35,10
133: Construction sites	-	61,52	-	-
211: Non-irrigated arable land	25,47	25,47	497,46	497,46
212: Permanently irrigated land	424,42	424,42	-	-
221: Vineyards	80,82	80,82	-	-
222: Fruit trees and berry plantations	-	-	11,93	11,93
223: Olive groves	-	-	636,71	636,71
231: Pastures	47,47	47,47	71,56	61,96
242: Complex cultivation patterns	949,98	949,98	1.134,50	1.134,50
243: Land principally occupied by agriculture, with significant areas of natural vegetation	4.245,38	4.246,49	3.616,42	3.616,42
311: Broad-leaved forest	129,80	296,48	240,27	398,04
312: Coniferous forest	3.164,64	2.946,99	5.804,09	5.637,69
313: Mixed forest	4.267,12	3.499,43	1.023,66	1.021,85
321: Natural grasslands	1.019,37	1.019,36	558,45	558,49
324: Transitional woodland-shrub	5.163,88	4.219,24	4.083,55	4.091,07
333: Sparsely vegetated areas	110,52	110,52	29,34	29,34
334: Burnt areas	49,86	-	-	-

Between the years 2000-2012, in terms of Belen's land use classes, changes took place in the built environment, agricultural areas, natural and semi-natural areas. With the openning of the road (35,10 ha), which was under construction in 2000, the settlement areas developed towards the agricultural areas in the northwest of the district; existing settlements are also developed on scrublands (167,06 ha). Also, the existence of an industrial facility (174,16 ha) operating in agricultural lands with private vegetation areas in the east of the district caused the built environment to grow in the area. During this period, significant changes were experienced in agricultural production classes. Especially, continuously irrigated agricultural lands (424,42 ha) connected to the fertile lands of the region disappeared completely, while non-irrigated arable lands (471,99 ha) and mixed cultivation areas increased. Besides, agricultural lands covered with special vegetation cover (630,07 ha) experienced massive land losses as industrial facilities, residential areas and agricultural production turned to orcharding. The transformation of existing vineyards into orchards (11,93 ha) and olive groves (636,71 ha) in horticultural agriculture and the location of these areas around the industrial facility show that the regional economy has developed with the agriculture-industry relationship. In natural and semi-natural areas, the land use class varies widely. Especially in mixed forest lands, mass area (2.475,77 ha) is lost, while the area increases are observed in coniferous forests (2.857,10 ha). The mixed/broad-leaved forests around the agricultural lands located in the center and south of the region in 2000 became coniferous forests in 2012. Among the reasons for this change in the diversity of tree species can be drying out, being cut down due to fire or forestry activities. It was observed that some of the shrub lands (135,69 ha) in the southern parts of the region were transformed into agricultural lands and some of them into forest areas. Natural grasslands, which are another part of semi-natural areas, were located only in the northern parts of the region in 2000, but as of 2012, they lost about half of their existing area (460,92 ha) and spread to the east and west of Belen. This spreading contributed to the covering of the surface areas by causing positive results in terms of areas covered with sparse vegetation (81,18 ha).

When the land cover map of 2018, which is the latest CORINE data, is evaluated, there is a minimal increase in industrial areas (9,65 ha) within the scope of built areas, while there is a small amount of area loss in pastures (9,60 ha) within the scope of agricultural areas. The change in the 6 years is seen as area loss in coniferous forests (166.4 ha) and area increase in broad-leaved forests (157,77 ha). In addition, there is an increase in area (7,52 ha) in shrub lands. Therefore, it is observed that the continuous change in natural and semi-natural areas still maintains its persistence.

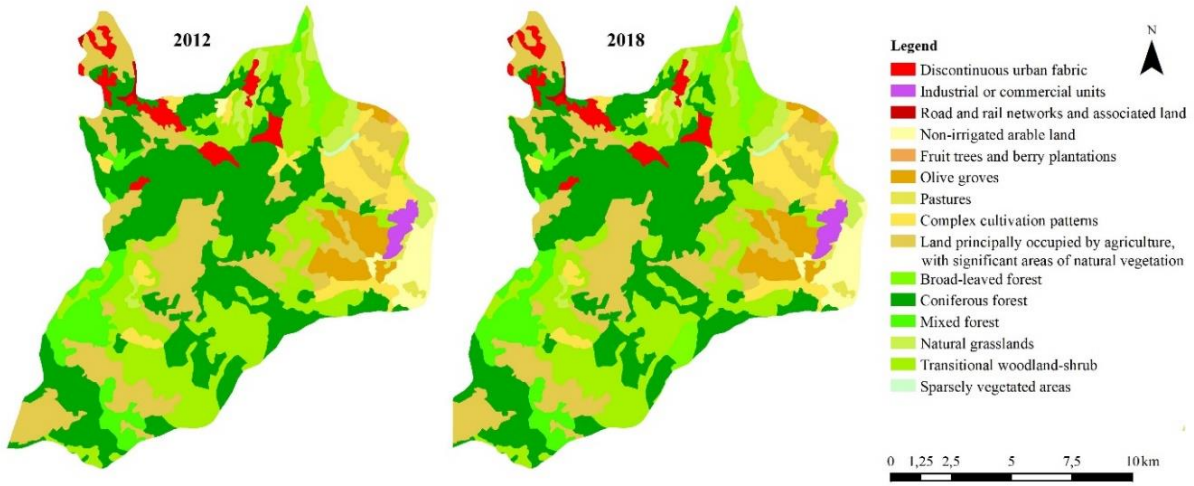

Figure 3. The Change in the Land Use of Belen Between 2012-2018

When the land cover class changes of Belen district are evaluated for 28 years, it is observed that significant area increases are realized in the built environment such as urban texture (191,99 ha), industrial areas (194,41 ha), connection zones (35,10 ha) of the region. The development of the built environment is on land covers with high ecological value such as production areas, forests, maquis and shrublands, meadows, and pastures around the city. In the urban growth process, the biggest loss in the production areas was experienced with the transformation of lands with high ecological value (628,96 ha) reserved for agriculture into industrial and residential areas. Significant differences have emerged in natural and semi-natural areas with the change of agriculture due to the built environment. The change in the production demand in the region with the development of the industrial structure caused the cover class of the land used for field agriculture (424,42 ha) to be included in the unused land (497,46 ha) class and the mixed cultivation areas (184,52 ha) to increase. The persistence of production continued as orchards with fruit (11,93 ha) and olive groves (636,71 ha). While there is a general decrease (503,98 ha) in forest lands, there are also losses in tree masses. Especially in mixed forests (3.245,27 ha), significant losses are experienced, while there are mass increases in coniferous forests (2.473,05 ha). It develops positively with the significant change in the temporal process of scrublands and their inclusion in forests and agricultural lands. In addition, the existence of areas with sparse vegetation and natural meadows, the reintegration of burnt areas (49,85 ha) into the natural structure play a pioneering role in maintaining biological balance and preserving the existing landscape values. Although areas with sparse vegetation cover (81,18 ha) are included in the meadows over time, the existing meadows (460,88 ha) are experiencing field losses.

Table 3. Developed land structures of Belen district by CORINE data between 1990 and 2018

Land structure	Parameter	Change
Built-up areas	Discontinuous urban fabric	+191,99
	Industrial or commercial units	+194,41
	Road and rail networks and associated land	+35,10
	Construction sites	-
Arable Farming	Non-irrigated arable land	+497,46
	Permanently irrigated land	-424,42
	Pastures	+14,49
	Complex cultivation patterns	+184,52
	Land principally occupied by agriculture, with significant areas of natural vegetation	-628,96
Horticulture	Vineyards	-80,82
	Fruit trees and berry plantations	+11,93

	Olive groves	+636,71
Forest land	Broad-leaved forest	+268,24
	Coniferous forest	+2.473,05
	Mixed forest	-3.245,27
Transition zone to forest	Natural grasslands	-460,88
	Transitional woodland-shrub	-1.072,81
	Sparsely vegetated areas	-81,18
	Burnt areas	-49,86

4. Conclusions and Recommendations

When the spatial change in land use classes between 1990-2000 is examined; the highest variation was in natural meadows, shrub areas, and mixed forests, respectively. However, it is thought that the built environment will develop depending on the time and cause a change in terms of natural/semi-natural areas. The change in the built environment between the years 2000-2012 is regarded as a turning point for Belen, in the form of agricultural production, the class change of natural and semi-natural areas, and issues related to the ecological structure of the region. According to the data of 2018, it is observed that the continuous change in natural and semi-natural areas still maintains its continuity.

The development of the built environment in Belen district continues on high ecological value land covers such as production areas around the city, forests, and shrub lands, meadows, and pastures. These structures, which form a transition between forest land and residential areas, should be considered due to their contribution to biodiversity and hence the ecological value of Belen. In the urban growth process, the biggest loss among the production areas was experienced with the transformation of lands reserved for agriculture but with high ecological value into industrial and residential areas. When the land use classes are evaluated in terms of forests, the losses in mixed forests and the increase in coniferous forests are especially important in Belen Nature Park, which is a protected area located within the boundaries of the district.

As a result, it has been revealed that Belen, which is an important settlement area at regional and urban scale in terms of ecological, economic, and agricultural indicators, shows changes in the direction of increase and decrease in terms of urban texture, forest areas, and agricultural areas according to the land use classification. These changes are important in terms of the landscape architecture professional discipline, especially in terms of the persistence of biodiversity/ecological balance of natural and protected areas. For this reason, the effect of the change in the built environment on the natural structure should be minimized. In the decisions to be taken for the future growth of the city, local administrations and public institutions should act together with the experts of the subject in terms of protection of agricultural areas, stabilization of natural/semi-natural areas, and ensuring the sustainability of protected areas.

Competing Interest / Conflict of Interest

The authors declare that they no conflict of interest. The none of the authors have any competing interests in the manuscript.

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