

**Araştırma Makalesi**  
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**Anahtar Sözcükler:**

Arazi kullanım değişikliği, Alan baskınlığı,

Sürdürülebilirlik, Üniversite yerleşkesi

**Sustainability in Green Structure: Ege University Campus**

Yeşil Yapıda Sürdürülebilirlik: Ege Üniversitesi Yerleşkesi

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**ABSTRACT**

**Objective:** Within the scope of this study, the spatial use changes of a university campus has been researched.

**Material and Methods:** Ege University Campus, which has an important place in the world, has been investigated over a period of 10 years by using orthophoto images of 2002, 2006 and 2011. In addition, analyzes were conducted for each year to determine the dominant usage types observed in research subareas.

**Results:** As a result, it has been seen that the agricultural and green open space character that can be perceived in early years has changed because of the new manmade constructions on these land types. Also it has been concluded that in the entire research area, the manmade areas were the most dominant land use type in the three examined years. Also the dominancy of agriculture, vegetation and no – vegetation areas decreased between the years 2002 and 2011.

**Conclusion:** In the light of the data obtained, general suggestions were given to give positive direction to the campus change. Also a proposed dominancy plan developed to increase the vegetation areas' dominancy overall the campus and to manage a green belt that surround the whole campus.

**ÖZ**

**Amaç:** Bu çalışma kapsamında bir üniversite yerleşkesinde gözlenen alan kullanım değişimleri analiz edilmiştir.

**Materyal ve Yöntem:** Ege Üniversitesi Yerleşkesinde 10 yıl boyunca gözlenen alan kullanımındaki değişimler, 2002, 2006 ve 2011 yıllarına ait ortofoto görüntüleri kullanılarak incelenmiştir. Ayrıca araştırma alt alanlarında gözlenen baskın alan kullanım tipleri belirlenmiştir.

**Araştırma Bulguları:** Çalışma kapsamında, ilk yıllarda saptanan tarımsal ve yeşil açık alan karakterinin, bu arazi tipleri üzerindeki yeni insan yapımı yapılar nedeniyle değiştiği görülmüştür. Ayrıca tüm araştırma alanında, yapay alanların incelenen üç yılda en baskın arazi kullanım türü olduğu sonucuna varılmıştır. Ayrıca, 2002 ve 2011 yılları arasında tarımın, bitki örtüsünün ve bitki örtüsü olmayan alanların baskınlığı azalmıştır.

**Sonuç:** Elde edilen veriler ışığında, kampüs değişimini olumlu yönde yönlendirmek için genel önerilerde bulunulmuştur. Ayrıca bitki örtüsü alanlarının kampüs genelindeki baskınlığını artırmak ve tüm kampüsü çevreleyen yeşil bir kuşağı yönetmek için önerilen bir baskınlık planı geliştirilmiştir.

## INTRODUCTION

Land use changes is a widespread and accelerating process, mainly driven by natural phenomena and anthropogenic activities, which in turn drive changes that would impact natural ecosystem. The detection of these changes are an important tool for understanding the the change of landscape dynamics during a known period of time. (Ruiz-Luna and Berlanga-Robles, 2003; Turner and Ruscher, 2004; Rawat and Kumar, 2015).

Urban areas can be understood as complex systems considering their intrinsic characteristics of emergence, self-organizing, self-similarity and non-linear behavior of land use dynamics. The use of tools designed for these systems that show the aforementioned characteristics will help us to get a better knowledge of the drivers behind urban land use dynamics that modifies through time and space due to human-made pressure (Barredo et al., 2003; Tahir et al., 2013).

The ability to monitor urban land cover / land use changes is highly desirable by local communities and by policy decision makers' alike (Yang et al., 2003). According to Steininger (1996), GIS technology provides a flexible environment for storing, analyzing, and displaying digital data necessary for change detection and database development (Weng, 2002). Appraising the present land use and its episodic change is convenient for urban planners, policy makers and natural resource managers (Tahir et al., 2013; Erasu, 2017) and the detection of the changes in the form of maps and statistical data is very vital for spatial planning, management and utilization of land (Singh and Khanduri, 2011).

Universities with large numbers of academic staff, students and administrative personnel and a variety of activities (e.g., working, studying, and business), even possessed their own independent infrastructure facilities (roadway, water supply, electrical supply, sewerage system, etc.) are comparable to small urban areas (Sohif et al, 2009; Norzalwi and Ismail, 2011; Asadi-Shekari, 2014). Determination of the changes observed in the university campus due to intense user capacity is important for the development of projections for these spaces and the planning decisions that need to be taken. In this respect the data obtained by remote sensing methods can lead these kinds of studies.

Satellite remote sensing provides both a high probability and cost-effective source of information for land cover mapping and quantifying environmental changes. Land use cover change detection is one of the basic requirements for effective planning and

management of environmental resources. The aim of change detection is to find areas that have been exposed to significant changes in land cover during the time periods in consideration (Eisavi et al., 2016; Helmy and El-Taweel, 2010).

Universities across the globe are recognizing the need to implement sustainable landscaping practices in order to support wildlife, improve water quality and positively impact human health and wellbeing (Ide and Rose, 2018). In this context, the aim of the study is to evaluate the land use change in Ege University – Turkey for a 10-year period by using orthophoto images. Temporal and spatial changes of land use were analyzed based on three land use maps, topographical maps taken in the years 2002, 2006 and 2011. As a result of the study, it is aimed to provide suggestions for the development of the research area and to be an example for similar study areas and research topics.

## MATERIAL and METHOD

### Material

The study area is the Ege University campus which is located in the Bornova district of the Izmir city. Ege University, founded in 1955, is Turkey's fourth university. Ege University covers an area between latitudes 38° 26' 53" – 38° 28' 02" N and longitudes 27° 12' 25" – 27 14' 31" E and it is under the effects of Mediterranean climate which has cool and rainy winters, hot and dry summers.

Dominant wind direction is northeast. North stellar wind and northeastern winds serve chilling effect in winter at Bornova and Ege University Campus. The campus which is located in the northeast of the city and far away 11 km. from the city center, is surrounded by Yamanlar mountain on the northwest, Manisa city on the east, Kemalpaşa Mountain on the southeast and Izmir Bay on the west and this area's height above the sea level is 33.05 m. (Küçükerbaş, 1991). The study area which's general soil structure is fertile agricultural land, was consist of large production areas and olive groves in the first years when it was established and has lost its agricultural character while the formation of the educational facilities over time.

Today, there are 15 Faculties, 9 Institutes, 6 Academies, 1 State Turkish Music Conservatory, 8 Vocational Schools, 5 Departments and 27 Application and Research Centers of Ege University. As of 2011-2012 academic year, Ege University has a total of 50,993 students as well as more than 3,135 academics and 4,000 administrative staff (Ege University, 2018).

Approximately 3445 hectares of the research area is examined primarily in three sub-sections, 1<sup>st</sup> subregion covers the Lodgings and has an area of 549 decares, 2<sup>nd</sup> subregion is the Main Campus which is 2034 decares and the 3<sup>rd</sup> subregion covers the Medical School Hospital with 862 decares of surface area.

### Method

The research method is conducted mainly in 3 stages. In the creation of the method of this study, the similar studies as (Heien and Jusuf, 2007; Hilton and Burkhard, 2009; Atik et al., 2010; Hepcan et al., 2011; Tan et al., 2014; Acheampong et al., 2018; Kalaycı Önaç et al., 2018; Wei et al., 2018) have been examined. In the first stage of the study the base images were created by correcting the topographic maps geographically with the IKONOS satellite images of the years 2002, 2006 and 2011, on the UTM 35N coordinate system with European 1950 Datum. The study area was divided into three subregions consist of Main Campus, Medical School Hospital and Lodgings. In order to assess temporal changes in the study area, the images belonging to different years were digitized according to land use categories. Structural and functional situation of the areas are taken into account as benchmarks while putting forward the land use types and four different land use categories (manmade, vegetation, no-vegetation, agriculture) which contain 13 different subclasses (buildings, concrete, car parking, construction, roads, canals, water surface, sports, very intense green area, moderately intense green area, low intense green area, soil, agriculture) has been created (Figure 1). In the second part of the study, a grid map consists of 421 grids, in which each grid has 10000 m<sup>2</sup> (100 m x 100 m) of an area, was created in order to make dominance analysis in the study area. For ensuring the accuracy of the dominance analysis, two of the grids which's area are less than % 5 within the boundaries of the grid are excluded from the study and totally 399 grids were taken into evaluation. The grids are taken into consideration through the 4 different land use classes with "spatial intersection analysis" and the grid maps were created separately for each year. The formula of  $RDa(\%) = (NDa \times 100) / TN$  (16) was used for the calculation of dominance percentages. In the formula  $RDa$  represents the dominance of land use class,  $NDa$  is the grid number in which the land use class is dominant and  $TN$  is the total number of the grids in the area. Mapping of land use types, classification and querying operations have been carried out through the geographic information system by the computer software Geomedia v. 6. The spatial changes of the

three periods were determined by "spatial difference analysis". Land-use statistical analysis was performed with Microsoft Excel® 2013. Finally, map composition, and labeling were all made with Photoshop CC 2014. In the third part of the study, general assessment was done according to the data obtained and recommendations and conclusions were put forward for the study area.

## RESULTS

### Land Use Types

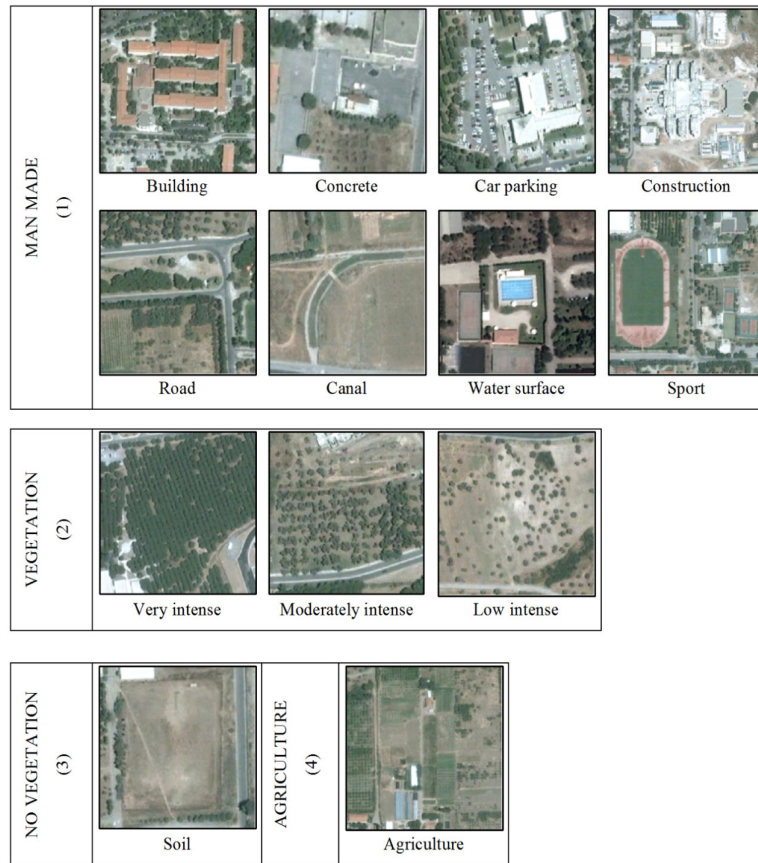
The research area is consisting of % 15.94 lodgings, % 59.03 main campus and % 25.03 hospital subregions. The numerical findings obtained as a result of the areal size analyses of each land use categories of 2002, 2006 and 2011 are given in Table 1.

It was determined that the "cannel" land use type was increased by 0.36 % at the main – campus subregion and decreased by 0.32 % at the hospital subregion. On the other hand, "cannel" surface was not detected at the lodgings subregion in the 10-year period of observation. As a result, it was seen that the cannel surface was increased by 0.04 % in total.

It was determined that "parking area" land use type had a very limited area at the lodgings and main campus subregions between the years 2002 – 2011 whereas the parking areas were mainly concentrated in the hospital subregion by 2006. In the 10-year period of observation, the parking areas were increased by 0.23 % at the lodgings and 12.45 % in the hospital subregions, on the other hand decreased by 0.23 % at the main campus subregion. As a result, it was seen that the parking areas were increased by 12.45 % in total.

It was observed that the "sport area", that had a limited surface area in the main campus and hospital subregions, was decreased 0.15 % in the main campus subregion and increased by 1.12 % in the hospital subregion between the years 2002 – 2011. In the 10-year period of observation, the land use type of sport area was not seen in the lodgings subregion. According to this, it was determined that the sport surfaces were increased by 0.97 % in total.

It was determined that the areal size of "road" surfaces in the main campus stayed the same between the years 2002 – 2011. Despite, there had been 0.66 % decrease in the lodgings subregion and 5.20 % increase in the hospital subregion during the 10-year period of observation. As a result, it was observed, the road surfaces were increased by 4.54 % in total.



**Figure 1.** Examples for the land use categories and sub classes in the research area.  
**Şekil 1.** Arazi kullanım kategorileri ve araştırma alanındaki alt sınıflar için örnekler.

There was not any “**water surface**” observed in the lodgings subregion between the years 2002 – 2011. The very limited water surface areas in the main campus and hospital subregions were not changed during the years 2002 – 2006. On the other hand, between the years 2006 – 2011, 0.02 % increase in the main campus subregion and 0.13 % increase in the hospital subregion were determined. According to these results, it was determined that water surfaces were increased by 0.15 % at the entire research area.

When all of these subcategories were evaluated as a whole under the title of “manmade”, it was seen that between the years 2002 – 2011,

- The manmade areas were dominant in the main campus and hospital subregions,
- The manmade areas were increased by 0.11 % in the lodgings subregion, 6.16 % in the main campus subregion and 22.45 % in the hospital subregion,
- The total manmade areas were increased by 9.28 % in the entire research area.

### Vegetation land use

In the 10-year period of evaluation, “**very intense vegetation areas**” increased by 19.03 % in the lodgings subregion, 2.16 % in the main campus subregion and 0.26 % in the hospital subregion. According to these it was determined that very intense vegetation areas were increased by 21.45 % in the entire research area. “**moderately intense vegetation areas**” decreased by 5.86 % in the lodgings subregion and 0.16 % in the main campus subregion, despite those increased by 0.72 % in the hospital subregion. As a result, it was determined that the mid dense vegetation areas were decreased by 5.30 % in total. “**low intense vegetation areas**” decreased by 7.49 % in the lodgings subregion and 4.91 % in the main campus subregion, on the other hand increased by 12.45 % in the hospital subregion. According to these it was determined that the less dense vegetation areas were increased by 0.05 % in total. When all of these subcategories were evaluated as a whole under the title of “vegetation”, between the years 2002 – 2011,

**Table 1.** The findings of each land use type in 2002, 2006 and 2011.**Tablo 1.** Her bir arazi kullanım tipinin 2002, 2006 ve 2011 yıllarındaki bulguları.

|             |               | LODGINGS SUBREGION |                |                |                | MAIN CAMPUS SUBREGION |                |                |                |                | HOSPITAL SUBREGION |                |                |                 |                 |                 |
|-------------|---------------|--------------------|----------------|----------------|----------------|-----------------------|----------------|----------------|----------------|----------------|--------------------|----------------|----------------|-----------------|-----------------|-----------------|
| 2002        |               | m <sup>2</sup>     | % <sup>1</sup> | % <sup>2</sup> | % <sup>3</sup> | % <sup>4</sup>        | m <sup>2</sup> | % <sup>5</sup> | % <sup>6</sup> | % <sup>7</sup> | % <sup>8</sup>     | m <sup>2</sup> | % <sup>9</sup> | % <sup>10</sup> | % <sup>11</sup> | % <sup>12</sup> |
| MANMADE     | Concrete      | 3067.10            | 0.56           | 7.04           | 1.12           | 3.91                  | 137680.12      | 6.77           | 30.11          | 17.77          | 61.97              | 57021.70       | 6.61           | 39.09           | 9.79            | 34.12           |
|             | Building      | 12880.80           | 2.35           |                |                |                       | 220976.20      | 10.86          |                |                |                    | 100088.97      | 11.60          |                 |                 |                 |
|             | Construction  | 0.00               | 0.00           |                |                |                       | 9704.40        | 0.48           |                |                |                    | 111724.06      | 12.95          |                 |                 |                 |
|             | Cannel        | 0.00               | 0.00           |                |                |                       | 14904.60       | 0.73           |                |                |                    | 3444.04        | 0.40           |                 |                 |                 |
|             | Parking area  | 550.10             | 0.10           |                |                |                       | 68009.00       | 3.34           |                |                |                    | 36925.84       | 4.28           |                 |                 |                 |
|             | Sport area    | 0.00               | 0.00           |                |                |                       | 44033.40       | 2.16           |                |                |                    | 3122.10        | 0.36           |                 |                 |                 |
|             | Road          | 22143.70           | 4.03           |                |                |                       | 116897.90      | 5.75           |                |                |                    | 24725.40       | 2.87           |                 |                 |                 |
|             | Water surface | 0.00               | 0.00           |                |                |                       | 157.20         | 0.01           |                |                |                    | 114.80         | 0.01           |                 |                 |                 |
| VEGETATION  | Very intense  | 213591.50          | 38.90          | 76.83          | 12.24          | 30.00                 | 455984.30      | 22.42          | 38.01          | 22.44          | 54.97              | 155659.30      | 18.05          | 24.51           | 6.14            | 15.03           |
|             | Mod. intense  | 95248.50           | 17.35          |                |                |                       | 141546.70      | 6.96           |                |                |                    | 36266.74       | 4.20           |                 |                 |                 |
|             | Low intense   | 112996.40          | 20.58          |                |                |                       | 175574.60      | 8.63           |                |                |                    | 19469.52       | 2.26           |                 |                 |                 |
| NO-VEGE.    |               | 88602.30           | 16.14          | 16.14          | 2.57           | 13.59                 | 254475.79      | 12.51          | 12.51          | 7.39           | 39.02              | 309040.00      | 35.83          | 35.83           | 8.97            | 47.39           |
| AGRICULTURE |               | 0.00               | 0.00           | 0.00           | 0.00           | 0.00                  | 394012.30      | 19.37          | 19.37          | 11.44          | 98.75              | 4993.22        | 0.58           | 0.58            | 0.14            | 1.25            |

| 2006        |               | m <sup>2</sup> | % <sup>1</sup> | % <sup>2</sup> | % <sup>3</sup> | % <sup>4</sup> | m <sup>2</sup> | % <sup>5</sup> | % <sup>6</sup> | % <sup>7</sup> | % <sup>8</sup> | m <sup>2</sup> | % <sup>9</sup> | % <sup>10</sup> | % <sup>11</sup> | % <sup>12</sup> |
|-------------|---------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|-----------------|-----------------|-----------------|
| MANMADE     | Concrete      | 6136.6         | 1.12           | 7.44           | 1.19           | 3.24           | 138348.7       | 6.80           | 31.29          | 18.47          | 50.54          | 43205.6        | 5.01           | 67.48           | 16.89           | 46.22           |
|             | Building      | 12787.3        | 2.33           |                |                |                | 224441.2       | 11.03          |                |                |                | 114938.52      | 13.32          |                 |                 |                 |
|             | Construction  | 132            | 0.02           |                |                |                | 12416.2        | 0.61           |                |                |                | 286593.45      | 33.22          |                 |                 |                 |
|             | Cannel        | 0              | 0.00           |                |                |                | 21527.4        | 1.06           |                |                |                | 704.77         | 0.08           |                 |                 |                 |
|             | Parking area  | 560.8          | 0.10           |                |                |                | 78305.2        | 3.85           |                |                |                | 96487          | 11.19          |                 |                 |                 |
|             | Sport area    | 0              | 0.00           |                |                |                | 41790.5        | 2.05           |                |                |                | 3172.14        | 0.37           |                 |                 |                 |
|             | Road          | 21237.8        | 3.87           |                |                |                | 119537.57      | 5.88           |                |                |                | 36845.81       | 4.27           |                 |                 |                 |
|             | Water surface | 0              | 0.00           |                |                |                | 157.2          | 0.01           |                |                |                | 114.8          | 0.01           |                 |                 |                 |
| VEGETATION  | Very intense  | 267006.36      | 48.63          | 73.50          | 11.71          | 30.23          | 458105.1       | 22.52          | 36.27          | 21.41          | 55.26          | 160763.47      | 18.64          | 22.47           | 5.62            | 14.52           |
|             | Mod. intense  | 72919.88       | 13.28          |                |                |                | 136359.8       | 6.70           |                |                |                | 13479.6        | 1.56           |                 |                 |                 |
|             | Low intense   | 63626.9        | 11.59          |                |                |                | 143315.3       | 7.05           |                |                |                | 19564.95       | 2.27           |                 |                 |                 |
| NO-VEGE.    |               | 104672.76      | 19.06          | 19.06          | 3.04           | 22.81          | 276230.74      | 13.58          | 13.58          | 8.02           | 60.20          | 77920.99       | 9.03           | 9.03            | 2.26            | 16.98           |
| AGRICULTURE |               | 0              | 0.00           | 0.00           | 0.00           | 0.00           | 383421.6       | 18.85          | 18.85          | 11.13          | 97.76          | 8804.59        | 1.02           | 1.02            | 0.26            | 2.24            |

| 2011        |               | m <sup>2</sup> | % <sup>1</sup> | % <sup>2</sup> | % <sup>3</sup> | % <sup>4</sup> | m <sup>2</sup> | % <sup>5</sup> | % <sup>6</sup> | % <sup>7</sup> | % <sup>8</sup> | m <sup>2</sup> | % <sup>9</sup> | % <sup>10</sup> | % <sup>11</sup> | % <sup>12</sup> |
|-------------|---------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|-----------------|-----------------|-----------------|
| MANMADE     | Concrete      | 4828.2         | 0.88           | 7.15           | 1.14           | 3.00           | 190431.44      | 9.36           | 36.27          | 21.41          | 56.40          | 118557.7       | 13.74          | 61.54           | 15.41           | 40.59           |
|             | Building      | 12895.4        | 2.35           |                |                |                | 252924.63      | 12.44          |                |                |                | 183742.8       | 21.30          |                 |                 |                 |
|             | Construction  | 1253           | 0.23           |                |                |                | 47736.98       | 2.35           |                |                |                | 0              | 0.00           |                 |                 |                 |
|             | Cannel        | 0              | 0.00           |                |                |                | 22183.32       | 1.09           |                |                |                | 704.77         | 0.08           |                 |                 |                 |
|             | Parking area  | 1788.7         | 0.33           |                |                |                | 63195.7        | 3.11           |                |                |                | 144296.72      | 16.73          |                 |                 |                 |
|             | Sport area    | 0              | 0.00           |                |                |                | 40953.82       | 2.01           |                |                |                | 12775.1        | 1.48           |                 |                 |                 |
|             | Road          | 18510.7        | 3.37           |                |                |                | 119501.54      | 5.88           |                |                |                | 69619.24       | 8.07           |                 |                 |                 |
|             | Water surface | 0              | 0.00           |                |                |                | 697            | 0.03           |                |                |                | 1165.08        | 0.14           |                 |                 |                 |
| VEGETATION  | Very intense  | 319539.4       | 58.20          | 82.77          | 13.19          | 32.39          | 499935.59      | 24.58          | 35.10          | 20.72          | 50.88          | 157959.7       | 18.31          | 27.21           | 6.81            | 16.73           |
|             | Mod. intense  | 63079.41       | 11.49          |                |                |                | 138208.2       | 6.80           |                |                |                | 51029.9        | 5.92           |                 |                 |                 |
|             | Low intense   | 71875.79       | 13.09          |                |                |                | 75735.2        | 3.72           |                |                |                | 25720.31       | 2.98           |                 |                 |                 |
| NO-VEGE.    |               | 55309.8        | 10.07          | 10.07          | 1.61           | 13.04          | 274697.8       | 13.51          | 13.51          | 7.97           | 64.78          | 94022.27       | 10.90          | 10.90           | 2.73            | 22.17           |
| AGRICULTURE |               | 0              | 0.00           | 0.00           | 0.00           | 0.00           | 307755.29      | 15.13          | 15.13          | 8.93           | 99.03          | 3002.1         | 0.35           | 0.35            | 0.09            | 0.97            |

|   |  |  |
|---|--|--|
| % <sup>1</sup> : The areal ratio of sub classes to public housing district  | % <sup>5</sup> : The areal ratio of sub classes to main campus district  | % <sup>9</sup> : The areal ratio of sub classes to hospital district   |
| % <sup>2</sup> : The areal ratio of main class to public housing district   | % <sup>6</sup> : The areal ratio of main class to main campus district   | % <sup>10</sup> : The areal ratio of main class to hospital district   |
| % <sup>3</sup> : The areal ratio between the main classes of public housing district and the entire research area | % <sup>7</sup> : The areal ratio between the main classes of main campus district and the entire research area | % <sup>11</sup> : The areal ratio between the main classes of hospital district and the entire research area |
| % <sup>4</sup> : The distribution ratio of main classes to the sub research areas                                 | % <sup>8</sup> : The distribution ratio of main classes to the sub research areas                              | % <sup>12</sup> : The distribution ratio of main classes to the sub research areas                           |



- Very intense green areas were determined to be more dominant than the other categories of vegetation in all subresearch areas,

- Vegetation areas had the biggest surface area among all the land use types in the lodgings subregion,

- Vegetation areas were increased by 5.94 % in the lodgings subregion, decreased by 2.91 % in the main campus subregion and increased by 2.70 % in the hospital subregion,

- All vegetation areas were found to be 0.10 % decreased in the entire research area.

### **No – Vegetation land use**

In the 10-year period of evaluation, it was seen that “no – vegetation areas” decreased by 6.07 % in the lodgings subregion, increased by 1.00 % in the main campus subregion and decreased by 24.93 % in the hospital subregion. According to these the no – vegetation areas were decreased by 30.00 % in the entire research area.

### **Agriculture land use**

It was seen that “agriculture areas” decreased by 4.24 % in the lodgings subregion and 0.23 % in the hospital subregion between the years 2002 – 2011. On the other hand, there was not any “agriculture areas” detected in the lodgings in the 10-year period. According to these it was determined that the agriculture areas were decreased by 4.47 % in the entire research area.

### **Area Dominancy**

The graphical maps of the land use types and the dominancy status of 2002, 2006 and 2011 are given in Figure 2.

## **DISCUSSION**

According to the results, in the 10-year period of evaluation it was determined that the dominancy of manmade areas increased by 14.68 %, vegetation areas decreased by 5.32 % , agriculture areas decreased by 1.7 % and no – vegetation areas decreased by 7.66 % . Consequently, it was determined that;

- Vegetation land use type was the dominant one in the lodgings in the three different years of examination.

- The dominancy of agriculture land use type remained the same in 2002 and 2006, but on the other hand decreased in 2011 because of the new manmade constructions on the agriculture areas.

- In the north of main campus and hospital subregions, the dominancy of vegetation areas that define the boundary of the campus, replaced by the dominancy of no – vegetation and manmade areas in 2011.

- In the south – west of the research area, the dominancy of no – vegetation land use type mostly replaced to the manmade dominancy between the years 2002 and 2006.

- In the entire research area, the manmade areas were the most dominant land use type in the three examined years. Also the dominancy of agriculture, vegetation and no – vegetation areas decreased between the years 2002 and 2011.

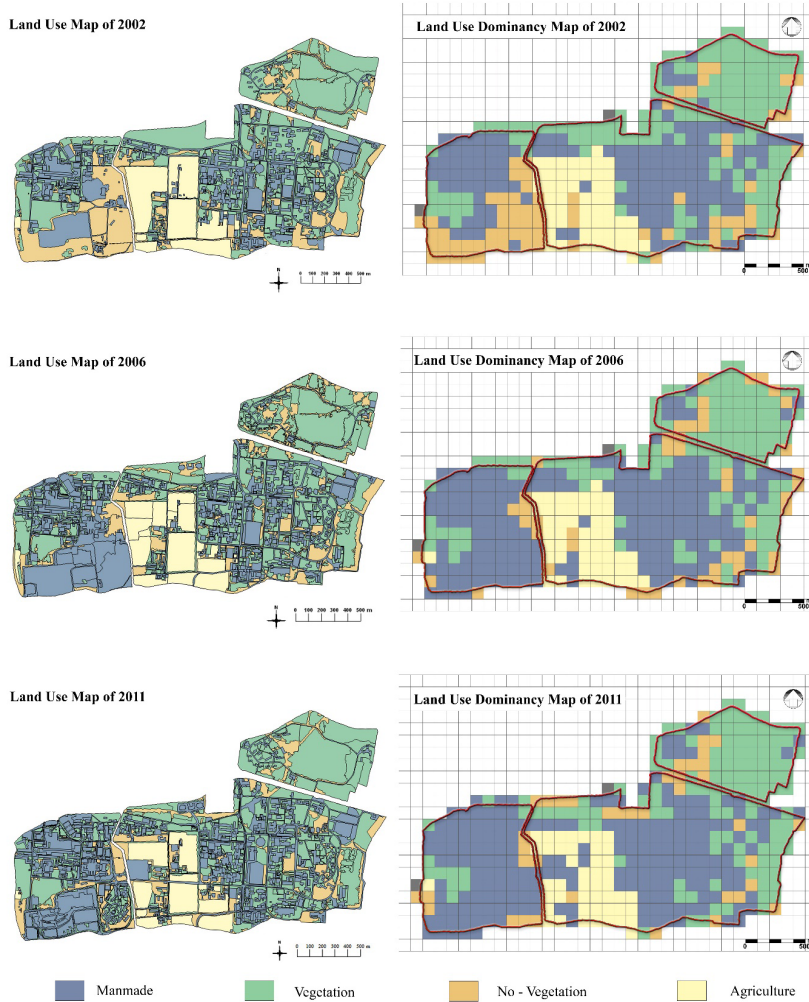
The Ege University Campus which is the study area of this research, the third largest university in Turkey, is established in 1955 on a huge farmland in Bornova district and has shown a continuous development and change since its early years. When Ege University Campus’ the last 10 years’ change has taken into account, its agricultural identity in early years has changed as well as its green open space character and mostly turned into a manmade character, also couldn’t reach a certain saturation level yet. When overall structuring of the campus has considered, it has seen that its area character has a massive characteristic, the vegetation class is collected especially in certain regions, and therefore a vegetation structure which is spread out homogeneously like encircling the entire area is unavailable. In the last 10 - year period the manmade structures have been constructed on the vegetation and agricultural areas and this caused a reduction of these land types’ dominancy overall the study area.

When the manmade land use class has taken into account, it was observed that the accumulation in main campus area is still continuing and the same situation is being seen with newly constructed buildings in Medical School Hospital subregion. In the observed period the rate of 35.8 % manmade dominancy has reached up to 50.48 % . When history of the study area that takes 58 years has been considered, this ratio of increase which took place in a very short time as 10 years is remarkable. It has been determined that there are two main reasons that cause this increase. Firstly, the university has started an accreditation process with other world universities and for this aim new educational and sportive facilities have been constructed for developing and enriching the facility infrastructure of the university. Second reason is due to the new transportation project which

covers overall Izmir City; the light rail system has to be passed through the campus area.

Another important point is there are still no – vegetation types of areas and undefined spaces in the research area. Although the no – vegetation class ratio has been decreased from 16.9 % to 9.29 % , this reduction can't be considered positive because of the increase in manmade areas in the observed period.

When the green area ratio is taken into account, the facts that while the vegetation area type in 2011 is observed as 40.72 % , the vegetation area dominance is found to be 29.29 % and in the same way while the man – made areas ratio base in m<sup>2</sup> was 37.95 % , their dominance overall the study area are determined as 50.48 % , revealed the result that if the dominance is concerned, the ratios actually in m<sup>2</sup> have a very different physical and especially perceptual meaning.

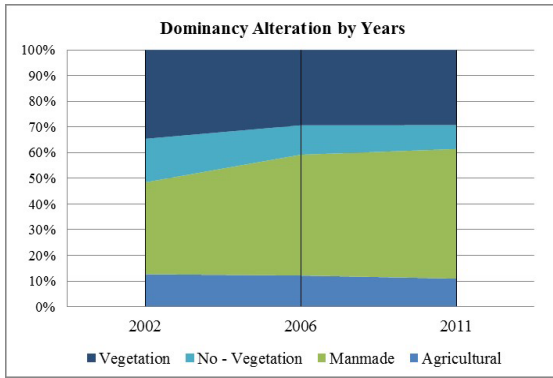


**Figure 2.** The study area's graphical maps of land use and land use dominance in 2002, 2006 and 2011.

**Şekil 2.** Çalışma alanının 2002, 2006 ve 2011 yıllarındaki arazi kullanımı ve arazi kullanım baskınlığı haritaları.

Overall the study area it was seen that;

- Between the years 2002 – 2006 the dominance of each land use type changed as; manmade areas increased by 11.22 % , vegetation areas decreased by 5.25 % , agriculture areas decreased by 0.48 % and no – vegetation areas decreased by 5.49 % .
- Also it was determined that between the years 2006 – 2011 the dominance of each land use type changed as; manmade areas increased by 3.46 % , vegetation areas decreased by 0.07 % , agriculture areas decreased by 1.22 % and no – vegetation areas decreased by 2.17 % (Figure 3).



**Figure 3.** Dominancy alteration of each land use type in 2002, 2006 and 2011.

**Şekil 3.** 2002, 2006 ve 2011 yıllarında her bir arazi kullanım türünün dominancy değişikliği.

According to these results;

- In the coming period the areas which are in no – vegetation character has to be converted to vegetation type across the campus area,
- New manmade areas musn't be constructed especially on the areas which are still in vegetation and agriculture classes,
- For increasing the vegetation dominancy overall, the study area new implementations need to be done.

### CONCLUSION

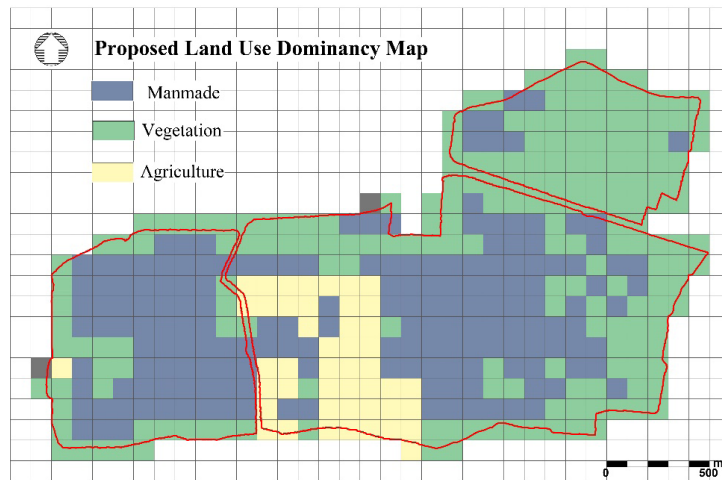
Urban growth leads to the change of land use / cover in many areas around the world, especially in developing countries (Belal and Moghann, 2011). In this context, land use / cover change are considered

one of the central components in current strategies for managing natural resources and monitoring environmental changes (Hegazy and Kaloop, 2015). Analyzing the land use / cover changes and understanding the current trends of change, contribute to present complex dynamics of land use / cover and is important for policy making, planning and implementing of natural resource management (Erasu, 2017; Ioannis and Meliadis, 2011; Knorr et al., 2011; Reddy and Gebreselassie, 2011).

University campuses which are usually built on large areas have an important potential with their education facilities and other indoor places as well as their open spaces for the cities. When considered as a whole the campuses which also serve the city residents in addition to the students and the staff can be thought as a prototype of the cities. Therefore, they have an important role on the urban ecosystem as well as their users with the natural and cultural assets that they own.

Preparation of a long – term master plan (map) which includes whole these development strategies is very important for a systematic and consistent improvement, preventing the reduction in vegetation spaces and also enhancing the manmade areas in a controlled way.

The map developed for the study area to increase the vegetation areas' dominancy overall the campus is presented in Figure 4 in which the vegetation areas' ratio increased by revising the whole no vegetation areas and also some manmade areas which are on the study area boundary line into vegetation class. Thus the study area is surrounded with a green area belt and the no vegetation areas have been refunctioned.



**Figure 4.** Proposed land use dominancy map of the study area.  
**Şekil 4.** Çalışma alanının için önerilen arazi kullanım baskınlık haritası.



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