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Determination Of Site Selection Criteria For Hospitals Cumayeri Sample (Duzce)

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Abstract

Success in hospital planning and design depends on choosing the appropriate hospital location. However, there are not enough studies to determine the site of the hospital. Geographic Information Systems is a tool that shows superiority over traditional methods in the planning stage of site selection studies. The aim of this study is to investigate and evaluate the natural and cultural characteristics of the area in the Cumayeri district of Düzce, and to provide an environmentally friendly, ecologically based, accurate assessment of the area with the help of GIS and to guide the selection of a qualified hospital area. In this study, data of geology, topography, soil and forestry maps were used. On the other hand, maps containing data such as hydrology, slope, view, land use, road network, and settlement areas were produced. In the light of all these data, “hospital suitability and landscape sensitivity maps” were created. An "optimal hospital area map" was created with the holistic evaluation of these two maps. Arc GIS 10.1 program was used in the production and data processing of all these maps. Then, according to the determined criteria, suitable areas for the establishment of a city hospital in Cumayeri district of Düzce province were determined.

Keywords: City hospital, site selection, GIS, landscape planning, Cumayeri.

Şehir Hastaneleri Yer Seçim Kriterlerinin Belirlenmesi Cumayeri Örneği (Düzce)

Özet

Hastane planlama ve tasarımında başarı uygun hastane yeri seçimine bağlıdır. Ancak hastane yer seçiminin belirlenmesi konusunda yeteri kadar çalışma bulunmamaktadır. Coğrafi Bilgi Sistemleri yer seçim çalışmalarının planlama aşamasında, geleneksel yöntemlere oranla üstünlük gösteren bir araçtır. Bu çalışmada Düzce İli Cumayeri ilçesinde alanının doğal ve kültürel özelliklerinin araştırılıp, değerlendirilmesi yapılarak çevreye uyumlu, ekolojik temelli, alanın en doğru şekilde değerlendirilmesinin CBS yardımı ile yapılarak nitelikli bir hastane alanı seçimi gerçekleştirilmesinde yol gösterici olması amaçlanmıştır. Çalışmada temel olarak, jeoloji, topografya, toprak ve amenajman haritalarının verileri kullanılmıştır. Diğer taraftan hidroloji, eğim, bakı, arazi kullanımı, yol ağı, yerleşim alanları gibi verileri içeren haritalar üretilmiştir. Tüm bu veriler ışığında “hastane uygunluk ve peyzaj hassasiyet haritaları” oluşturulmuştur. Bu iki haritanın bütüncül değerlendirilmesi ile “optimal hastane alan haritası” oluşturulmuştur. Tüm bu haritaların üretiminde ve veri işlemeleri aşamasında Arc GIS 10.1 programı kullanılmıştır. Daha sonra belirlenen kriterlere göre Düzce İli Cumayeri ilçesinde şehir hastanesi kurulması için uygun alanlar ortaya konulmuştur.

Anahtar Kelimeler: Şehir hastanesi, yer seçimi, CBS, peyzaj planlama, Cumayeri.

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1. Introduction

Today, global warming, environmental pollution, wrong practices in agriculture and food sector, alcohol, smoking etc. and stress threaten human health and cause diseases to increase. While selecting hospitals for treatments, their health service, meeting the expectations at the highest level and providing the best opportunity is effective for people. The sustainability of the hospitals of the same type of health service depends on the physical conditions and their location as well as the health services they provide. The fact that usually people choose hospitals that are reliable for their treatment, easy to access, with both structural and outdoor features and designs shows how important hospitals location is (Organ and Tekin, 2017).

The most important issue in the selection of the location of the hospital is being easy access to the area and the possibility of expansion as a result of the need to increase (Güneş, 2006; Ayan, 2009). Besides these, it should be paid attention that hospitals should have hard ground due to earthquakes, landslides and similar risks, have flat or close to flat areas in terms of pedestrian and vehicle transportation, the hospital rooms should be located in the south, east and between these directions so that the rooms can make the most of daylight, they should not be exposed to strong wind, have beautiful scenery, be noiseless, have plenty of oxygen, not being affected by dust, smoke, odor and their transportation infrastructure is solved, swamp or ground water is not high, in terms of accessibility they should be established by public transport connected with city center- station-airport and have connections with emergency stations, and there should be infrastructure (water-electricity-natural gas, garbage, sewage, etc.) services, have areas with green texture (Akgün, 2018).

Success in hospital planning and design depends on the selection of the most appropriate locations The right and most effective use of the available resources and opportunities is of great importance in terms of ensuring "Sustainability" which is one of the current problems of investment in the future. The aim of this study is to ensure that both Düzce Province and neighboring provinces make the best use of health services and to guide the planners and local decision makers with an ecological based approach in the selection of the site of the city hospital by determining the suitable areas for the placement of the city hospital on the border of Cumayeri District with the help of GIS in order to improve quality. In this way, the importance of GIS will be highlighted in site selection analyzes for use-recreation and service areas to be established with the health investment to be made. In the same way, while searching for solutions to today's problems, it will contribute to the best possible planning, design and investment studies by considering the possible positive and negative effects in the future.

2. Materyal ve Metot

2.1. Materyal

Cumayeri District, which has been selected as a study area, is connected to Düzce District and is located in the West Black Sea Region. District It is surrounded by Çilimli in the east, Gümüşova in the south, Sakarya in the west and north, and Akçakoca in the northeast. The district center is 20 km to the city center, 261 km to Ankara, 160 km to Istanbul and 81 km to Bolu. Cumayeri is built on 10.011 ha land (Figure 1). The center of the district has a lake floor covered with alluvium and the elevation is 112 m. The district consists of 21 villages and 30 neighborhoods. Settlements in the villages are in the form of scattered settlements specific to the Black Sea region (Anonymous, 2020).

Study area covers an area of approximately 88,79 km² within the borders of Cumayeri District of Düzce Province. In the determination of the current natural and cultural characteristics and field boundaries of the study area, 1/25000 scaled maps and the following primary and secondary sources were used:
- General Command of Mapping, 1997 (G25-b1 / G25-b2 and G25-b3) Adapazarı topographic maps,
- General Directorate of Forestry, 2008 forestry maps and reports
- General Directorate of Rural Services, Soil and Water Resources National Information Center, soil maps and reports
- Google Earth (updating existing locations),
- Düzce Provincial Environmental Status Reports (2011, 2012, 2016)
- Projects, articles, thesis, papers, regulations and laws and similar resources
- Geographic Information Systems (GIS, ArcMap 10.1 software) (to create a database, create maps and analyze the workspace).

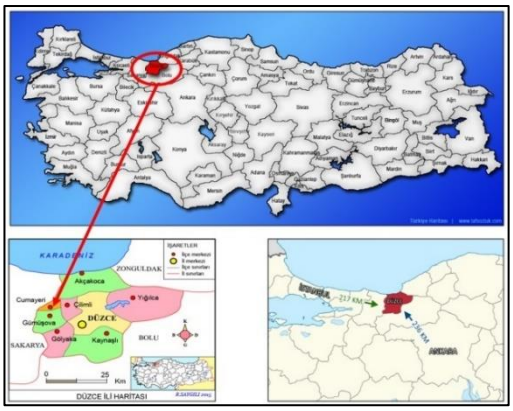

Figure 1. Workspace location (URL -1 2019).

2.2. Metot

The study was carried out in three stages: data collection, digitization of data and analysis-synthesis of data. These stages are detailed below:

Data Collection: In this section, data collection, previous studies in the field of city hospital and hospital planning, maps, reports, articles and similar data were examined and investigated.

- Digitization of data: The natural and cultural data obtained were processed and stored in the GIS environment by means of ArcGIS 10.1 program

- Analysis and synthesis of data: Analysis and synthesis of data: In the analysis of data section, coefficients in the range of 1-3 are assigned to natural and cultural landscape elements and data according to the importance of choosing the location for the city hospital. For each selected element, a subset of values was assigned in the range of 1-5 (Table 1).

The opinion of 5 experts from the Department of Landscape Architecture and forestry engineering of the Faculty of Forestry of Düzce University was taken into account in the selection of natural landscape elements and subunits and in the determination of points values. Conformity maps were formed by calculating the assessments in the GIS environment. Natural data, which is one of the important factors in the location selection of the city hospital areas, has been carefully evaluated in terms of geology, geomorphology, available area uses, management data, hydrology and categorized according to their importance. Likewise, cultural data were evaluated in terms of settlement, transportation and accessibility and value was assigned. Natural data, which is one of the important factors in the location of the city hospital integrated facility areas, has been carefully evaluated in terms of rock types, slope, existing area uses, aspect, hydrology and canopy, and categorized among themselves according to their importance. Likewise, cultural data were evaluated and examined in terms of settlement and transportation and value assignment was made. Among these criteria, rock types, slope, use of the available area and transportation are the most important aspects, hydrology and transportation are the most important, and closure is the least important. Transportation settlement and hydrology data were displayed in the maps.

After the conformity analysis, “Water Infiltration Analysis” and “Potential Erosion Risk Analysis” were performed to determine the areas sensitive to the landscape. Five classes were identified in the sensitivity analysis and the following is listed;

- Areas where landscape sensitivity is “High” and “Very High Areas” where eligibility for urban hospital building is “Less Suitable”,
- Areas where landscape sensitivity is moderate “Moderate Areas” suitable,
- Areas with “Low” and “Very Low Landscape” Sensitivity are classified as “Very Suitable Areas” for Construction.

In the synthesis stage of the method, 88,7952 km^2 of Cumayeri District, which is the study area, was conducted with the help of GIS and sensitivity analysis. After these analyzes, which constitute a basis for the city hospital, planning and design suggestions were developed for the areas identified as “Very Suitable”, “Suitable” and “Not Suitable” for the city hospitals.

Table 1. Site selection criteria, scoring and reasons table of city hospital area.

SELECTED NATURAL AND CULTURAL FACTORS					
WS	**Criteria**	**Sub Criteria**	**SCP**	**TP**	**Reason**
3	ROCKS TYPES	Sandstone-Mudstone, Shelf, Slope	0	0	According to the regulation on the buildings to be built in the earthquake zone, solid rocks, undifferentiated solid rocks, hard cement sedimentary rocks are included in the group A which is considered to have high strength in studies. Areas with high ground water, alluvial, loose sand and soft clay-like soils are in the D group, which is not suitable for construction and which is a wet soil group (Anonymous, 2019).
		Sandstone, Mudstone, Limestone, Shelf	0	0	
		Quaternary, Alluvium	0	0	
		Clay Limestone, Shelf, Slope	3	9	
		Andesite-basalt-volcanic-rock	5	15	
		Shale, Slope, Sedimentary Rock	3	9	
3	SLOPE	%0-2	4	12	It should be ensured that the land to be selected in city hospitals should have low slope and be free from environmental pollution, noise and other environmental effects (Anonymous, 2010a).
		%2-6	5	15	
		%6-12	3	9	
		%12-20	0	0	
		%20-30	0	0	
		>%30	0	0	
3	AVAILABLE AREA USE	Degraded forest	4	12	The use of forest areas should be avoided in order not to destroy wildlife and natural areas due to the pressure of construction in such areas. When planning such facilities, institutions such as Municipalities and the Ministry of Health should be partners in the exchange of information. Otherwise, disagreements between zoning plans and other areas planned for use may cause problems such as ownership problems (Anonymous, 2010a).
		Hazelnut	5	15	
		Broad leaf forest	1	3	
		Min	0	0	
		Agriculture	1	3	
		Residential	0	0	
2	ASPECT	North	0	0	Ventilation and local wind circulation should be provided in the design of hospital buildings. For the patient rooms to receive heat and light, it would be appropriate to prefer the south and east sides. In particular, the largest aspect of the building should be built on the southern aspect due to (energy saving for warming and bright patient rooms with long lighting) the regional climate. Structures should not interfere with each other, should be planned and designed to be least affected by cold winds (Altan, 2003).
		Northeast	0	0	
		East	5	10	
		Southeast	4	8	
		South	5	10	
		South West	3	6	
		West	3	6	
		Northwest	0	0	
		All	4	8	
2	HYDROLOGY	Stream 0-300 m	0	0	Drinking water and basins should be protected. With the precautionary measures and legal regulations, suitable construction and usage areas are allowed after a certain distance to drinking water and rivers (200-300 m) (Anonymous, 2017).
		Stream> 300 m	5	10	
1	CLOSENESS	0-Closed Cavity	5	5	The rate of forest presence in our country is less than that of other developed countries. While the developed countries have forest assets around 79.7 million ha, this ratio is 22.3 million ha in our country (Yeşildağ, 2009), which shows the priority and importance of preserving the existing forest areas. As a result of these planning decisions to be made for conservation purposes, it was taken care not to select areas that are fully closed. It is also intended to protect wildlife.
		2-Closed Medium	1	1	
		3-Off_Full Off	0	0	
3	TRANSPORTATION	Intercity Road (0-300 m)	0	0	City hospitals areas should be kept away from noise in open areas. Health investments to be made should be planned to cover 250 m from the limit of very sensitive uses (Anonymous, 2010b). In planning the location of the facility, the population of the region, future projections, and number of users, transportation and accessibility, traffic density and flow rates and the requirements of the existing road system should be determined and calculated.
		Intracity Road (300-2000 m)	5	15	
2	SETTLEMENT	Proximity to town center (0-750 m)	0	0	By moving away from the district center, air quality is improving, and city hospitals are generally preferred in places far from the district center (Anonymous, 2010a).
		Proximity to town center (750-200 m)	5	15	

WS: Weight Score (1:less effective **2:**medium effective **3:**very efficient**)**, **SCP: Sub Criteria Point (0:**no effect **1:**little effective **2:**less effective **3:**effective **4:**very efficient **5** too effective), **TP:** Total Point

3. Findings and Discussion

At this stage of the study, maps and tables related to natural and cultural landscape elements were created. In the same way, the maps of the conformity-sensitivity-suggestion areas were included after the analyzes.

3.1. Maps of Natural and Cultural Landscape Elements

When we examine the study area in terms of slope, the regions with a slope of at most> 30% and at least a slope with 2-6% are located. In the area, the steep slopes are in the northern part of the area. The flat and near regions are located to the south (Figure 2).

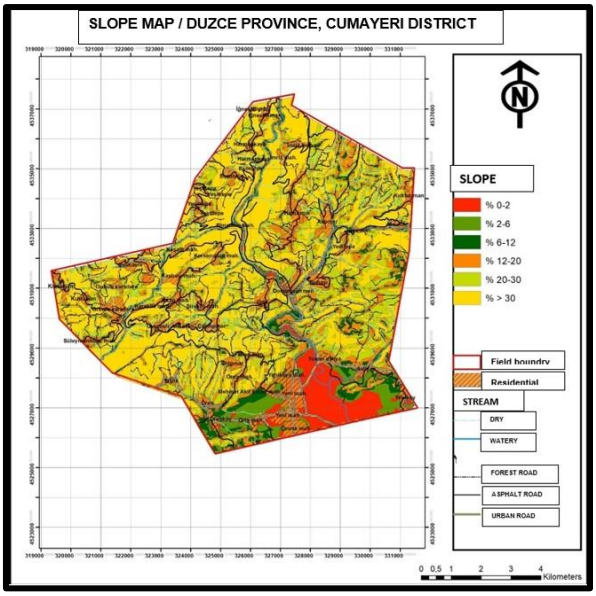

Figure 2. Work area slope map.

When the evaluation of the study groups was made, the southern aspect was the higest. Afterwards, it is observed that north, southeast, east and southwest aspects (Figure 3).

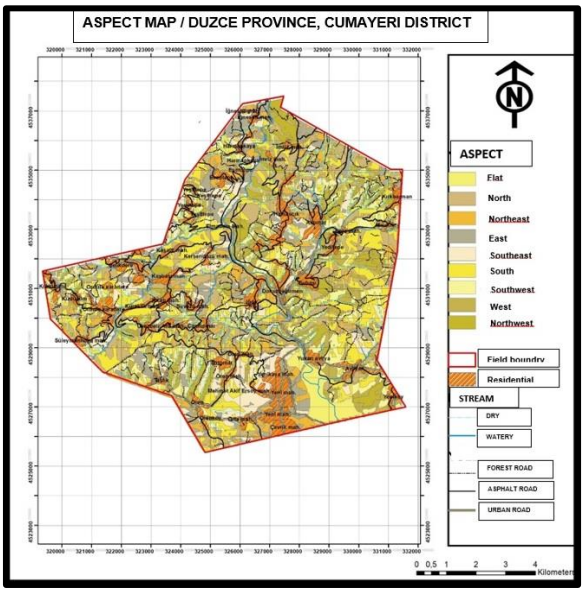

Figure 3. Work area aspect map.

In terms of rock types, sandstone-mudstone-shelf-slope takes the most places in the study area, while sandstone-mudstone-limestone-shelf is very small. Andesite-basalt-shelf-slope-volcanic rock, where the settlement is suitable, is observed in an area east of Cumayeri district. Alluvial soils are located in the district center where the altitude and slope are very low (Figure 4).

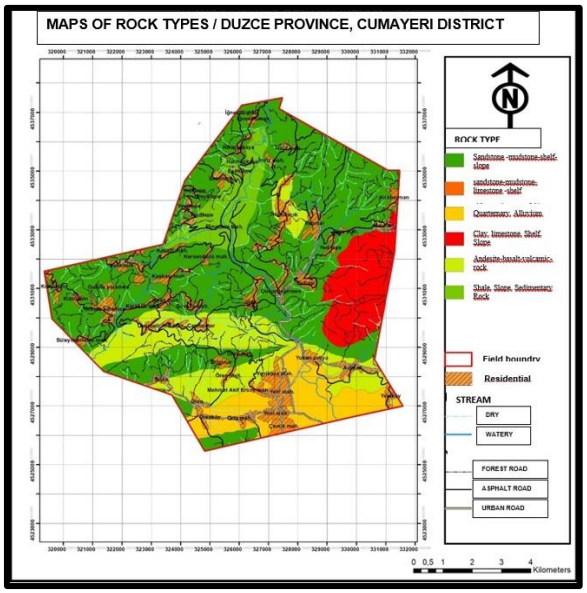

Figure 4. Map of rock types.

Forestry and Google Earth data were evaluated by the General Directorate of Forestry and the current land use status of the area was determined. Broad-leaved forest, degraded forest, hazelnut, agriculture, mines and settlement areas are mapped. Agricultural areas, forest and settlement area are the most common area. Other areas consist of degraded forests, mines and hazelnuts (Figure 5).

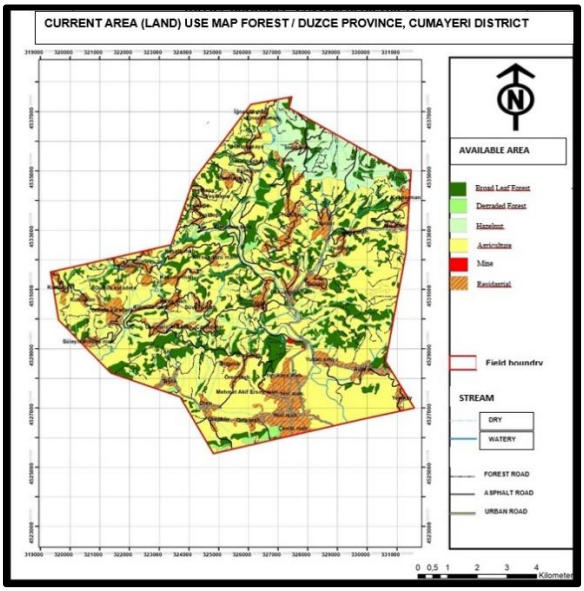

Figure 5. Current area (current land) use map forest.

In the study area respectively, there are areas with closed, fully closed and medium closed forest cover with the most spaces (Figure 6).

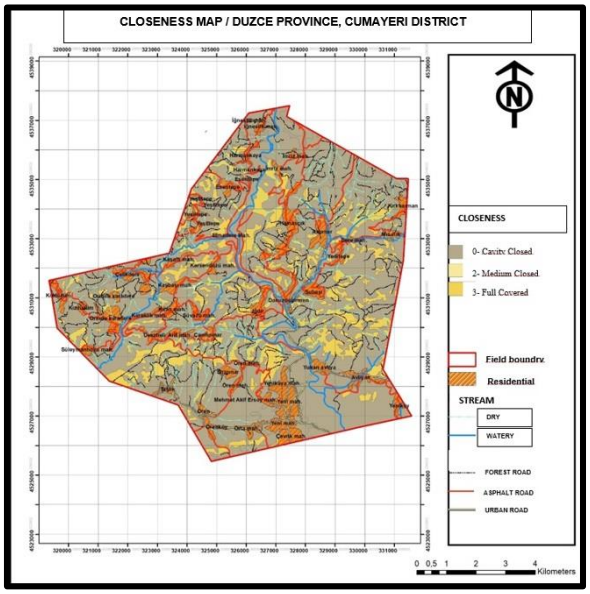

Figure 6. Stand closure map.

In terms of transportation, the areas within 300-2000 m of urban road transport are located close to the district center of Yukarıavlıyan-Avlıyan and Yeniköy neighborhoods. Likewise, Mehmet Akif Ersoy neighborhood and Ören Neighborhood are among the places deemed appropriate (Figure 7).

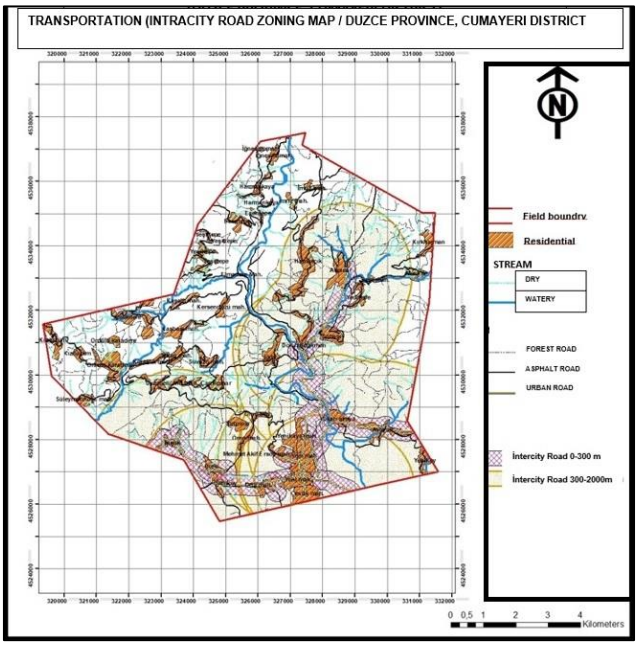

Figure 7. Transportation (ıntracity road zoning) map.

In addition, in terms of settlement (distance to the center of the district), the places where the settlement is dense and outside the areas between 0-750 m. which are close to the district center, A 2000 m zoning was performed and the hospital was planned to be built in these areas (Figure 8).

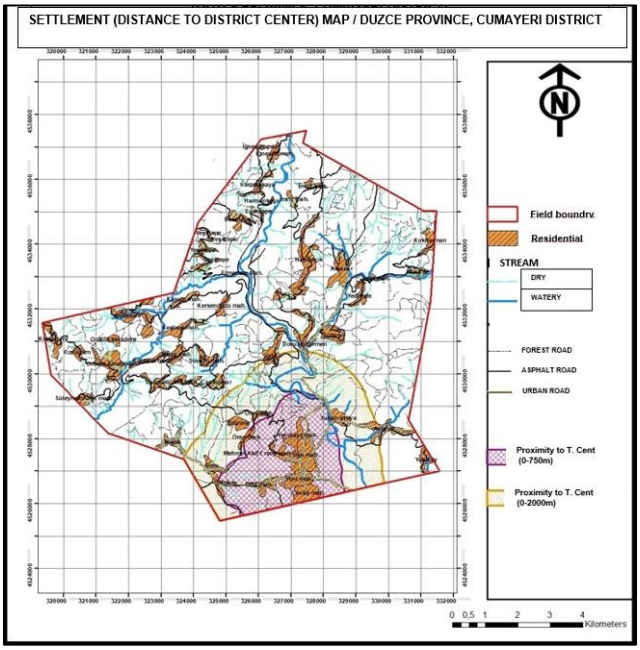

Figure 8. Settlement (distance to district center) map.

3.2. Maps Created After Analsis

After evaluating the natural and cultural data of the study area according to their importance, a map of conformity was obtained with the help of GIS for city hospital site selection (Figure 9). When the maps prepared as a result of the scores made for the purpose of conformity analysis were examined, it was seen that the study area selected for the city hospital was very effective in the formation of suitable areas in terms of slope.

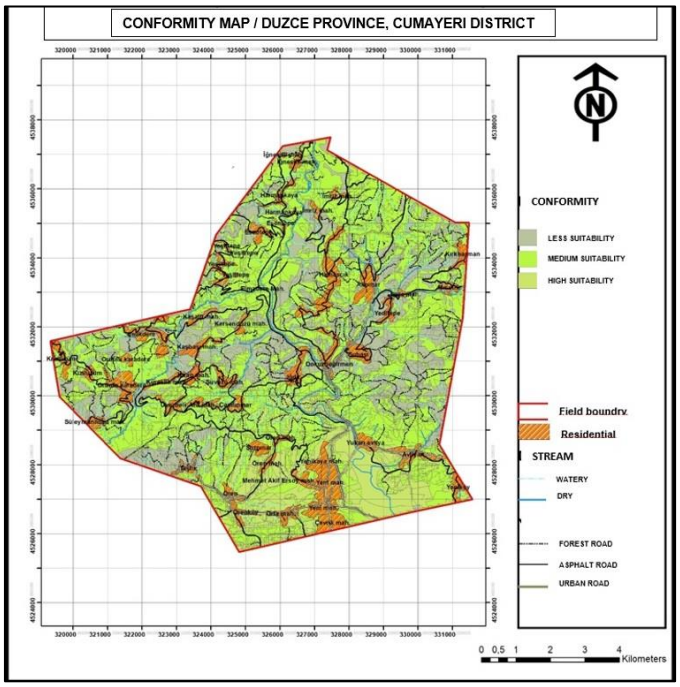

Figure 9. Conformity map.

In terms of Ecological, economic, aesthetic and functionality, “Suitable Areas” emerged near the transport network and to the south of the study area where the slope was low for the city hospital area. The areas with high slope

were found to be Less Appropriate and the areas with medium slope were Moderate. Within the scope of the study, water process analysis and erosion process analysis and protection-oriented method approach and sensitivity analysis have been carried out in order to form a basis for high-scale plan decisions that will contribute to the development of the region and the province, and to be a source of data, to detect the permeable, soft-structured areas where landscape sensitivity is high (Buuren, 1994; Şahin, 1996; Şahin and Kurum, 2002; Uzun, 2003; Uzun et al., 2010; Uzun et al., 2011; Uzun and Gültekin, 2011).

Water process analysis includes the formation of infiltration map by overlapping soil structure permeability values and geological structure permeability values. The erosion risk potential includes the formation and synthesis of Soil Protection Degrees map obtained by overlapping vegetation and slope maps and the Wearability Map obtained by overlapping geology and slope maps. Both methods were used to determine the sensitive areas by overlapping the maps (Figure 10).

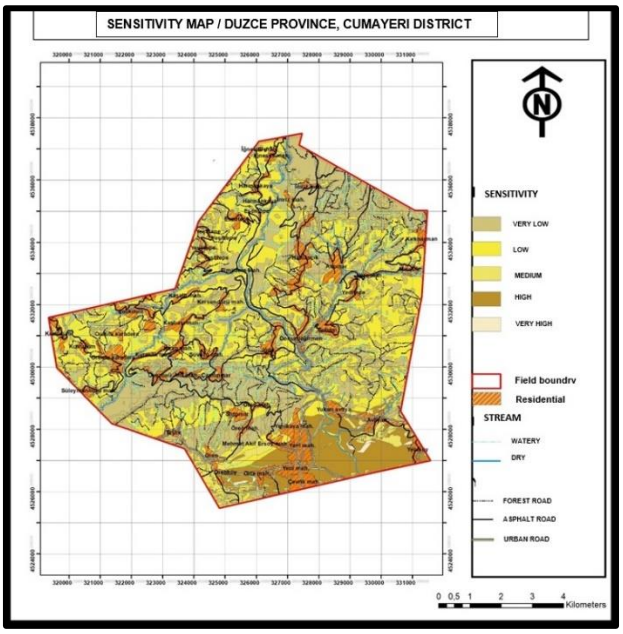

Figure 10. Sensitivity map.

Very high and high areas with the highest sensitivity are located in the alluvial soils in the south of the study area. The areas where the sensitivity is medium–low and very low are spread over the study area. The conformity and sensitivity maps created were overlapped and a suggestion–optimal areas map was produced in the study area for the city hospital. So;

- Landscape sensitivity with very high and high–less suitable areas = areas not optimally appropriate (Not Appropriate)
- Landscape sensitivity medium–medium suitable areas = optimally appropriate areas (appropriate),
- Low and very low landscape sensitivity–very appropriate fields = optimally considered the most appropriate fields (Very Appropriate) (Figure 11).

As a result of the conformity analysis and sensitivity analysis conducted with the help of GIS in Cumayeri District of Düzce, the suggestion city hospital areas were determined as “very appropriate”, “appropriate” and “not appropriate” (Table 2). Inappropriate areas include areas with high slope, broad-leaved quality forest areas, and asphalt road (round trip) in terms of transport quality and to the north of the study area. The areas where the sensitivity is very high consist of a small part in the south of the study area. Again, the areas with high sensitivity are located close to the district center where alluvial soils are located to the south of the study area. Very suitable areas cover very little area in the study area. Suitable areas were found in the east of the study area near the high sensitivity area and between Yeniköy and the district center where the alluvium is located.

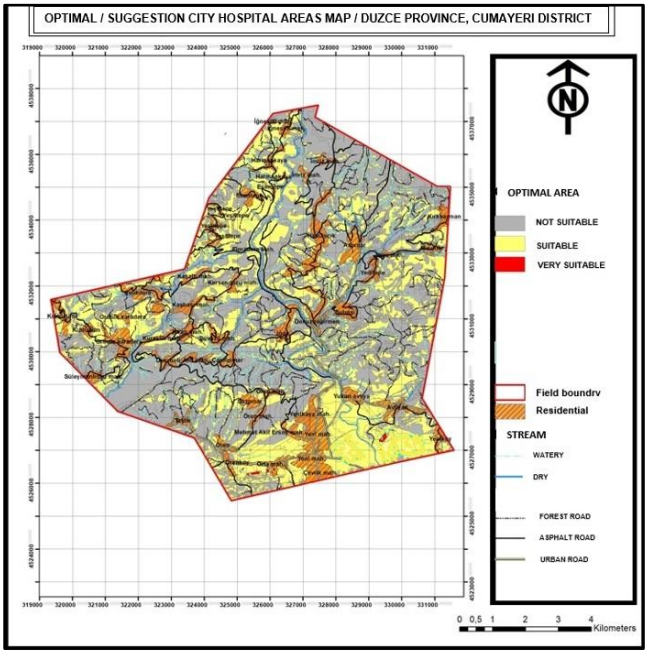

Figure 11. Optimal / Suggestion city hospital areas map.

Table 2. Suggestion areas table

Suggestion Area			
Type	**Area (km²)**	**Total Area (km²)**	**Percentage**
Not Suitable	49,23		55,67%
Suitable	40,11	88,79	44,84%
Very Suitable	0,55		0,10%

Shackell and Walter (2012) emphasize that in the planning and design of hospital gardens, the features of the existing area should be determined, the design should be connected with nature and the area should be included in the green texture. Pirli (2020) stated in his study that when choosing the area for hospitals, areas that are close to the residential area and the transportation network should be preferred. When choosing areas for hospitals according to Anonymous 2010a; due to risks such as earthquakes and landslides, areas with solid ground properties should be selected. It should be avoided from swamps or high ground water areas. In their study, Marcus and Sachs (2014) emphasized that criteria such as the amount of daylight the area will receive in the facility of hospital gardens, orientation to the sun and the dominant wind direction should be considered.

4.Results and Recommendation

In accordance with the study carried out in the Cumayeri District of Düzce, appropriate areas for the construction area of the city hospital; In terms of rock types, it is considered that the areas where there is a strong rock structure such as andesite-basalt should be preferred, however, since it is seen that there are very few such rocks in the area, the study area was selected where alluvial soils dominated (Figure 4), in areas where the slope is 0-2% and mostly 2-6%, aspects are south, southwest, and east (Figure 3), Even though it is thought that the degraded forests and hazelnuts should be preferred in terms of the usage of the existing area, due to the abundance of the agricultural areas, these areas come out as the usage area (Figure 5), surface waters are not within the protection zone 0-300 m, and the degree of closure is hollow and closed (Figure 6), it is in the 300-2000 m range determined by zoning to intracity road in terms of proximity to transportation network, as a result of the landscaping sensitivity analysis conducted in the 750-2000 m range from the district center in terms of settlement, it was revealed that there are medium and high sensitivity areas.

In line with the analysis, the fact that electing the areas where the city hospital, will be established from flat or close areas, agricultural areas and landscaping are located in sensitive areas of urbanization is based on such areas, high impact of proximity to city or district center in terms of accessibility are derived from the reasons mentioned.

In the light of the planning study for the study area, the design process should be started while preserving the resource values of the study area. In this process, the opportunities provided by natural resources should be best reflected in the field. Infrastructure and superstructure needs of the areas where city hospitals will be established, hospital unit service buildings, special rehabilitation gardens, green areas, children playgrounds, temporary waste warehouses, guest house, commercial areas (taxi stops, medical markets, cafeteria, buffet, pharmacy), parking areas and similar visitor capacity and the needs of the region should be designed. The relevant laws and regulations should be reviewed before the construction of these facilities.

In addition to the results of the study, another important point that was mentioned is that in the last months of 2019, after the Covid-19 epidemic that entered our lives, the importance of city hospitals increased as well as the changing health awareness of people. In this direction, the location of hospitals in cities, being close to residential areas, being accessible, being close to transportation networks, their capacities, and the amount of open green areas should be taken into consideration in the selection of hospital locations. Generally, the construction of new buildings in hospital gardens or the provision of additional parking lots is seen as a constant requirement. In addition, empty and green areas in hospital gardens are seen as open and suitable spaces for the creation of new buildings according to needs. For this reason, the selection of the area in the construction phase of the hospitals is the most important factor to be considered.

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