



Land Use in the Coastal Zones with Environmental Impacts on the Estuary and Beaches: Case Study of Tekkeönü River Basin and Hisar-Ovatekkeönü Beaches of Bartın, Turkey

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Abstract

Coastal zone river basins are significant landscapes not only from their aesthetic and recreational features but also from their land use characteristics and associated environmental impacts. In this study, the buffer zones were designated within the Tekkeönü river basin of Bartın, Turkey using the Geographical Information Systems (GIS). Thus, the land use and slope situations of the buffer zones and overall river basin were determined. According to the results of this study, the agricultural areas constitute approximately the 48% of the 0.5 km buffer zone. On the other hand, they cover 40% of the 1 km buffer zone. However, the agriculture and grazing are practiced at relatively the steep lands where the slope degree is more than 10°. The rural settlements are scattered at almost 22% and 16% of the 0.5 km and 1 km buffer zones respectively. In addition, the handicapped forests spread about 21% and 23% of these buffer zones respectively. About 12% of these handicapped forests exist on the relatively steep slopes (>10°) of the Tekkeönü river basin. The agricultural areas and handicapped forests are potential threats for the soil erosion and river pollution particularly at the steep slopes of the river basin. Therefore, conservative precautions should be taken in order to achieve sustainable management of the basin, estuary and beach.

Keywords: Coastal zone, Land use, GIS, Environmental impacts, River basin, Estuary and beach.

Kıyı Bölgelerinde Arazi Kullanımı ile Haliç ve Plajlarda Çevresel Etkiler: Tekkeönü Nehir Havzası ve Hisar-Ovatekkeönü Plajları (Bartın, Türkiye) Örneği

Öz

Kıyı bölgesi nehir havzaları, yalnızca estetik ve rekreasyonel özelliklerinden dolayı değil, aynı zamanda arazi kullanım özelliklerinden ve buna bağlı çevresel etkilerden dolayı önemli peyzajlardır. Bu çalışmada, Tekkeönü havzasında (Bartın, Türkiye) Coğrafi Bilgi Sistemleri (CBS) kullanılarak tampon bölgeler belirlenmiştir. Böylece, tampon bölgelerin ve bütün nehir havzasının arazi kullanım ve eğim durumları tespit edilmiştir. Çalışmanın sonuçlarına göre, tarımsal alanlar 0.5 km'lik tampon bölgenin yaklaşık %48'ini oluşturmaktadır. Öte yandan bu tarımsal alanlar, 1 km'lik tampon bölgenin %40'ını kaplamaktadır. Bununla birlikte, tarım ve otlatma, eğim derecesinin 10°'den fazla olduğu nispeten dik bölgelerde uygulanmaktadır. Kırsal yerleşimler sırasıyla, 0.5 km ve 1 km'lik tampon bölgelerin yaklaşık %22'sinde ve %16'sında dağılmıştır. İlave olarak, bozuk ormanlar sırasıyla bu tampon bölgelerin yaklaşık %21 ve %23'ünde yaygınlık göstermektedir. Bu bozuk ormanların yaklaşık %12'si Tekkeönü havzasının nispeten dik yamaçlarında (>10°) bulunmaktadır. Tarım alanları ve bozuk ormanlar, özellikle nehir havzasının dik yamaçlarında, toprak erozyonu ve nehir kirliliği açısından potansiyel tehditler oluşturmaktadır. Bu nedenle havzanın sürdürülebilir yönetimi için koruma odaklı tedbirler alınmalıdır.

Anahtar Kelimeler: Kıyı bölgesi, Arazi kullanımı, CBS, Çevresel etkiler, Nehir havzası, Haliç ve plaj.

INTRODUCTION

Coastal zones are significant regions having valuable ecological characteristics, sensitive biodiversity, and delicate ambience. Namely, they possess pristine environments with scenic seaside landscapes and beaches. Hence, they are attractive to the people for offering them instantaneous and temporal recreation (Marsh, 2010). Recreational activities are particularly the touristic visits that involve traveling and walking through the area, enjoying visual pleasure, swimming, sunbathing etc.

Beyond the short-term recreational activities, coastal zones, shores and beaches are susceptible to the impacts of human who intend to alter these natural and unspoiled environments via attempting land use change (Ürgenç, 2000). Their direct and indirect impacts are often associated with land use conversions and mostly result in major long-term transformations (Alphan, 2005).

Land use change within the coastal zones is in particular initiated with introducing houses to the region. The sprawl of houses subsequently occur in the form of urban or rural settlements usually followed by the associated further land uses such as agricultural areas, transportation lines, commercial places, public fields and etc. (Hepcan et al., 2013).

Either in short or long terms, anthropogenic utilization of the coastal zones and beaches involving particularly the tourism pose more or less threats on the environments of these unique landscapes (TSPO, 1997). Therefore, they are vulnerable from social pressure. In terms of land use concept, coastal zones should be evaluated within the basin scale (Randolph, 2004). Thus, impacts of land use conversions on the coastal zone environment may comprehensively be addressed and solution proposals in order to prevent and mitigate these problems can be developed. Consequently, sustainable landscape planning objectives are able to be inclusively met within the basin scale.

Coastal zones with estuaries, where the river drains its water and sediments collected from the basin into the sea must significantly be monitored and assessed (Berberoğlu, 2003). Because, the seas and beaches around are exposed to the basin-induced pollutions such as turbidity and organic wastes. At least, those seas and beaches become prone to the degradation of aesthetic and visual quality especially after the heavy rainfalls. Around these overall perspectives, basin land use factors; settlements, agricultural areas and handicapped forests influencing the physical and chemical characteristics of the river discharges should be discussed in detail.

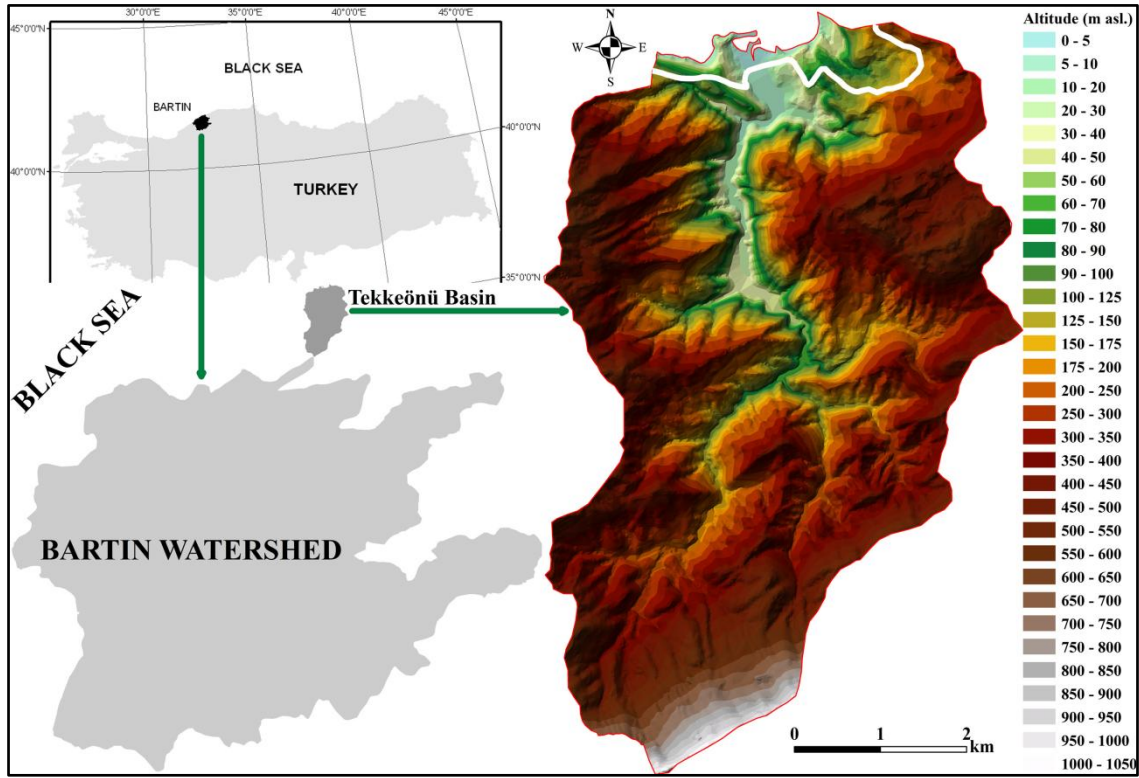


Figure 1. Location and altitudinal gradients of Tekkeönü basin within the Bartın watershed and Turkey. The road passing through the basin is displayed with white color at the coastal northern edge of the basin.

MATERIAL AND METHOD

Western Black Sea coasts of Turkey are generally rugged (Atalay, 1982). Mountains and cliffs have emerged almost immediately near the sea at most of the region. Besides, the geomorphology pattern of the basins of the rivers that drain into the Black Sea is also mountainous (Gökyer et al., 2015) allowing limited transportation and settlement along the coasts. These morphological difficulties in transportation and settlement within the region have, to some extent, led to the protection of both the coastal zones and inlands.

Tekkeönü basin which covers approximately 32 km², is located in the northwestern coastal zone of Turkey between 32°64' and 32°71' eastern longitudes, and between 41°75' and 41°83' northern latitudes (Figure 1). The altitude of the basin extends from the sea level up to the 1050 m asl whereas the average is 322 m asl. (Figure 1). The basin consists of the main Tekkeköy River and its tributaries. The approximate length of the main river is about 3 km with the channel bottom slope of only 1°. Average slope of the basin is 22° which is relatively steep. On the other hand, dominant aspects of the basin are towards north-west and north.

Annually, the average total precipitation is 1046 mm. Respectively, May (49 mm precipitation) and October-December (121 mm precipitation for each) are the driest and wettest months (TSMS, 2014). For the coldest (January) and hottest (July) months,

the mean temperatures are 4.1°C and 22.3°C respectively whereas the average annual temperature is 12.6°C (TSMS, 2014). Western-northwestern and northern-northeastern winds are prevalent for the coastal zone (TSMS, 2014). The snow cover dominates December and January with the depth of 15 cm in average (TSMS, 2014). Consequently, the coastal zone drops into the humid mesothermal climate regime (Atalay, 2011). The gray-brown podsollic and alluvial soils (TMFAL, 2005) have formed on limestones, sandstones, mudstones, conglomerates and vulcanite-sedimentary rocks (TGDMRE, 2007).

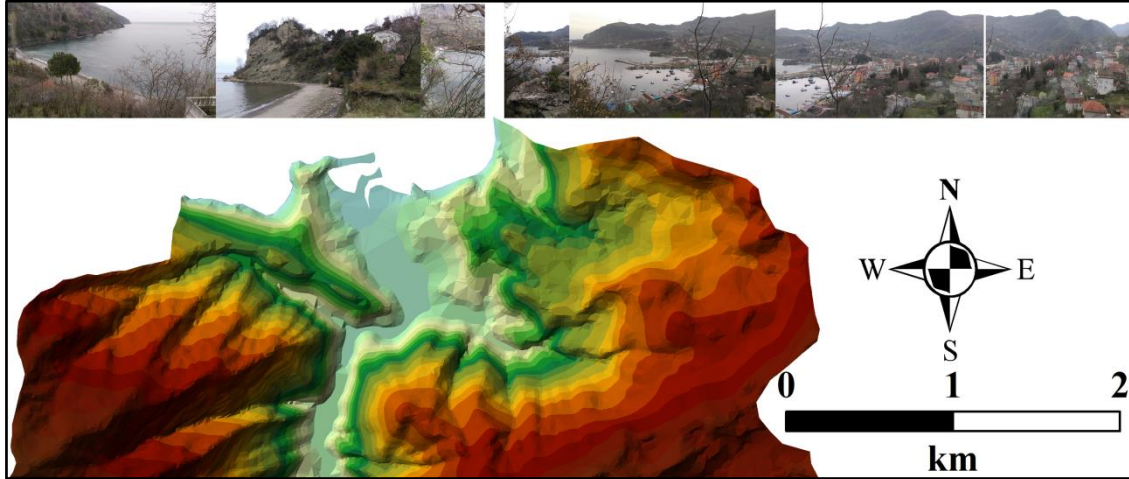


Figure 2. Ovatekkeönü town with photographs at both sides of the headland.

The river drains into the Black Sea throughout the Ovatekkeönü town which is home to two beaches located at both sides of a headland (Figure 2). The headland now covered with trees and shrubs involves an historical castle. The lengths of the beaches at the western and eastern sides of the headland are 750 m and 1 km respectively. The western beach is relatively more unspoiled compared to its eastern companion. Besides, the Ovatekkeönü town, the river basin consists of villages scattered particularly close to the agricultural areas which cover about 20% of the basin. The rest of the Tekkeönü basin is almost covered with forest which includes pure and mixed stands of pines (*Pinus pinea*, *nigra*, *pinaster*, *sylvestris*, and *brutia*), beeches (*Fagus orientalis* Lipsky), hornbeams (*Carpinus betulus* L.), oaks (*Quercus robur* and *petraea*), and chestnuts (*Castanea sativa*) (Figure 3) (TGDF, 2011). However, almost 13% of the river basin is covered by handicapped forest stands with canopy closure of 10% or more often less than this (TGDF, 2011).

Despite the difficulties in transportation and settlement, road and building problems are tried to be overcome by tunnel construction and landscape grading applications. Furthermore, a new road construction campaign is introduced to the region which involves those tunnels and road enlargement practices along the coast (Öztürk and Gökyer, 2016). All of these development facilities will possibly lead to the invitation of new buildings into the recent settlements which are only in the already form of villages and towns. The expansion of these settlements will then favor urbanization which simultaneously will trigger population increase. This social

pressure might force the coastal zones and beaches causing environmental degradation and natural disturbances.

Part of the town where the river meets the sea is the Tekkeönü bay with the estuary particularly formed by the sediments carried down by the river. The beaches serve for the summer season. The sea is loaded with sediments after the heavy rainfalls in particular. The existence of handicapped forests and agricultural areas within the estuary zone and buffer zone of the river may trigger this situation.

In this study, two buffer zones with 0.5 km and 1 km widths were determined and delineated within the Tekkeönü river basin using the Geographical Information Systems (GIS). The land uses and slope degrees were analyzed and exhibited within the river basin referring to the GIS tools. Consequently, the situation of the actual land use and associated slope degrees were defined in order to predict potential threats and propose environmental precautions for the river basin.

RESULTS AND DISCUSSION

Almost half of the 0.5 km buffer zone of the river is dominated by the agricultural areas whereas about 40% of the 1 km buffer zone is prevailed by those agricultural areas (Table 1). Those agricultural areas pose threats to the river and the beaches via supplying sediments and together organic and inorganic pollutants mainly in the form of manures and fertilizers into the river. On the other hand, the settlements primarily in the form of town and secondarily the villages cover almost 22% and 16% of those buffer zones respectively (Table 1). The impervious surfaces including in particular the buildings and roads block the infiltration and stimulate the overland flow-surface runoff frequently sweeping the dust and pollutants into the river. Moreover, respectively almost 21% and 23% of these buffer zones are covered by the handicapped forests (Table 1).

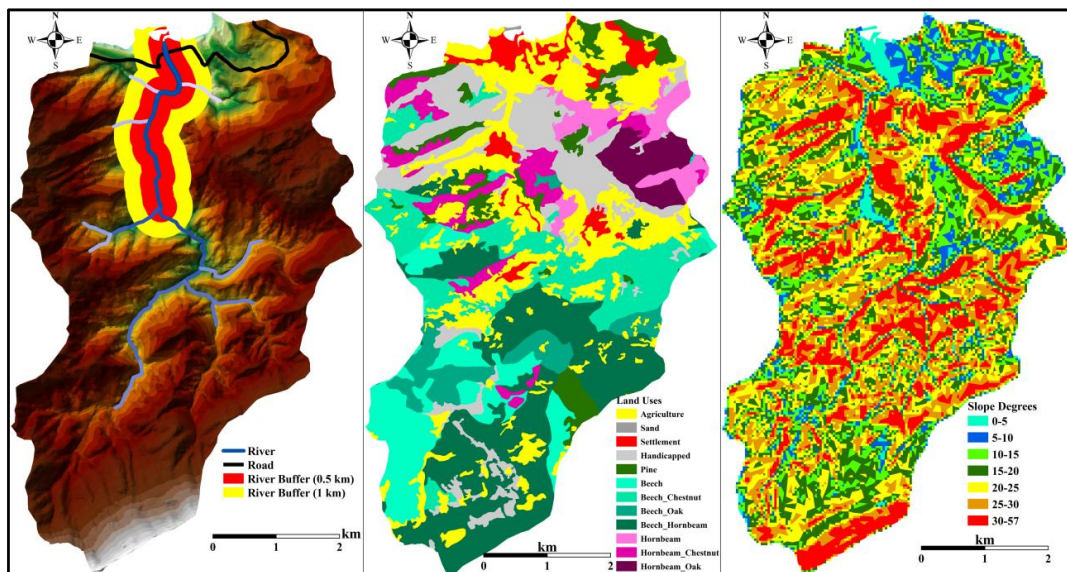


Figure 3. The buffer zones (0.5 km and 1 km), land uses and slope degrees within the Tekkeönü basin.

Table 1. Distribution of land uses within 0.5 and 1 km river buffers.

Land Use	Buffer (0.5 km)	Buffer (1 km)
<i>Agriculture</i>	47.5%	40.0%
<i>Sand</i>	0.4%	0.4%
<i>Settlement</i>	21.5%	15.9%
<i>Handicapped</i>	20.5%	22.6%
<i>Pine</i>	2.3%	5.4%
<i>Beech-Chestnut</i>	1.5%	4.7%
<i>Beech-Oak</i>	0.0%	0.6%
<i>Hornbeam</i>	0.4%	1.3%
<i>Hornbeam-Chestnut</i>	5.9%	9.1%

Furthermore, the agricultural cultivation and grazing is practiced relatively at the steep areas with slope degree of higher than 10° which again feeds the overland flow rather than infiltration. Hence, the overland flow and surface runoff sequentially reach the river channel, estuary, beaches and ultimately to the sea. Those relatively steep agricultural areas constitute more than 16% of the Tekkeönü basin (Figure 3 and Table 2). The town and village settlements are also located at relatively the steep slopes (Figure 3 and Table 2). The steep upstream of the river basin is partially covered with the forests which tend to conserve the soil against landslides and water erosion, protecting the physical and chemical quality of overland flow water and river channel flow water. However, at more than the 12% of the relatively steep slopes (>10°) of the Tekkeönü river basin, the handicapped forests occur (Figure 3 and Table 2). These handicapped forest stands with canopy closure of around and less than 10% are comparatively away from conserving the soil and protecting the water quality.

Table 2. Distribution of land uses according to the ranges slope degrees of the overall basin.

Land Use	Slope Degree Ranges						
	0-5°	5-10°	10-15°	15-20°	20-25°	25-30°	30-57°
<i>Agriculture</i>	1.32%	2.62%	3.61%	4.77%	4.59%	2.58%	0.86%
<i>Sand</i>	0.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
<i>Settlement</i>	0.63%	0.89%	1.06%	0.62%	0.28%	0.14%	0.01%
<i>Handicapped</i>	0.18%	0.50%	1.35%	2.42%	2.68%	2.64%	3.19%
<i>Pine</i>	0.07%	0.34%	0.53%	1.02%	1.50%	1.34%	0.77%
<i>Beech</i>	0.07%	0.37%	0.91%	1.75%	2.45%	2.18%	1.69%
<i>Beech-Chestnut</i>	0.12%	0.60%	1.25%	1.97%	2.46%	2.48%	2.57%
<i>Beech-Oak</i>	0.04%	0.20%	0.44%	0.87%	1.25%	1.26%	0.75%
<i>Beech-Hornbeam</i>	0.14%	0.56%	1.62%	3.54%	4.37%	4.41%	5.04%
<i>Hornbeam</i>	0.07%	0.28%	0.52%	0.58%	0.63%	0.69%	1.00%
<i>Hornbeam-Chestnut</i>	0.03%	0.14%	0.34%	0.69%	1.21%	1.42%	1.20%
<i>Hornbeam-Oak</i>	0.21%	0.69%	0.96%	0.78%	0.41%	0.16%	0.08%

CONCLUSIONS AND RECOMMENDATIONS

Settlements in the form of town and villages are spreading within the buffer zones of the river channel. Their dwellers try to practice agricultural cultivation within these buffer zones of the river channel and even at the rather steep slopes. The handicapped forests occur largely within these buffer zones. Consequently, the handicapped forests and agricultural areas pose threats for the sustainable coastal zone landscape and beach management.

Within the buffer zones, riparian zones should be reserved between the agricultural areas and the river channel. The handicapped forests particularly within the buffer zones should be repaired and rehabilitated. The sprawl of the town and the villages should be directed towards the higher altitudes away from the river channel and buffer zones. Additionally, especially within the buffer zones, biofertilizers should be promoted instead of the artificial fertilizers for the agricultural areas.

The forest lands at the higher altitudes of the Tekkeönü river basin should be conserved. The pressure on the land uses should be mitigated. The farmers should be encouraged to lead their livestock out of the buffer zones of the river channel. In order to protect the range biodiversity and therefore conserve the soil, the farmers should be informed to practice livestock grazing out of the early-spring period when the perennial plants flourish. Besides, the livestock grazing should also be avoided during the late-autumn. Thus, the sustainability of the soil conservation against erosion will be provided.

REFERENCES

- Alphan, H and Yilmaz K. T. (2005). Monitoring environmental changes in the Mediterranean Coastal Landscape: The case of Çukurova, Turkey. *Environmental Management*. 35(5): 607-619. DOI: 10.1007/s00267-004-0222-7.
- Atalay, İ. (1982). *Introduction to the Geomorphology of Turkey* (in Turkish). İzmir, Turkey: Ege University, Faculty of Social Sciences Publications.
- Atalay, İ. (2011). *Climate Atlas of Turkey* (in Turkish). İstanbul, Turkey: İnkılâp Bookstore.
- Berberoğlu, S. (2003). Sustainable Management for the Eastern Mediterranean Coast of Turkey. *Environmental Management*. 31(3): 442-451. DOI: 10.1007/s00267-002-2724-5.
- Gökyer E, Öztürk M, Dönmez Y, Çabuk S. (2015). Evaluation of ecotourism activities using geographic information systems in mountain areas of Bartın City. *İnönü University Journal of Art and Design*. 5(12): 25-35.
- Hepcan Ş, Hepcan Ç. C, Kılıçaslan Ç, Özkan M. B, Koçan N. (2013). Analyzing landscape change and urban sprawl in a Mediterranean coastal landscape: A case study from İzmir, Turkey. *Journal of Coastal Research*. 29(2): 301-310. DOI: 10.2112/JCOASTRES-D-11-00064.1.
- Marsh, W. M. (2010). *Landscape Planning; Environmental Applications*. Fifth Edition. New Jersey, USA: John Wiley & Sons Inc.
- Öztürk, M and Gökyer, E. (2016). Spatio-temporal Characteristics of Roadside Landscape Components Along the Coastal Zone Between Amasra and Kurucaşile Cities of Bartın

Province, Turkey. 5th Fábos Conference on Landscape and Greenway Planning, June 30-July 3, 2016, Budapest, Hungary.

Randolph, J. (2004). *Environmental Land Use Planning and Management*. Island Press. Washington, USA.

TGDF (Turkish General Directorate of Forestry), (2011). Forest Management Plans of Bartın Forest Administration. Ankara, Turkey.

TGDMRE (Turkish General Directorate of Mineral Research and Exploration), (2007). Digital Geological Maps of Zonguldak F-29 Section. Ankara, Turkey.

TMFAL (Turkish Ministry of Food, Agriculture and Livestock), (2005). Digital Soil Maps of Bartın Stream Watershed. Ankara, Turkey.

TSMS (Turkish State Meteorological Service), (2014). Daily Meteorological Data. Ankara, Turkey.

TSPO (Turkish State Planning Organization), (1997). National Environmental Action Plan; Land Use and Coastal Land Management (in Turkish). Ankara, Turkey: İller Bankası Publications.

Ürgenç, S. İ. (2000). *Rural Landscape; Conservation-Reclamation-Organization* (in Turkish). İstanbul, Turkey: Yıldız Technical University, Faculty of Agriculture Publications.