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The need for ecosystem-based coastal planning in Trabzon city (TR)

Mustafa Dihkan[1*], Nilgün Güneroğlu[2], Abdülaziz Güneroğlu[3], Fevzi Karslı[1]

[1]Karadeniz Technical University, Faculty of Engineering, Dept. of Geomatics, 61080 Trabzon TR
[2]Karadeniz Technical University, Faculty of Forestry, Dept. of Landscape Architecture, 61080 Trabzon TR
[3]Karadeniz Technical University, Faculty of Marine Science, Dept. of Marine Ecology, 61530 Trabzon TR

* Corresponding author
Tel : +09212 498 4260
E-mail : mdihkan@ktu.edu.tr tr

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Abstract

Coastal urbanization problem was emanated from willingness of coastal living. Urban sprawl is one of the most important coastal problems in Turkey as it is in Trabzon city which is known for its natural and historical assets. In order to ensure the sustainability and ecological continuity of the city, an ecosystem based coastal planning is an issue of high priority. Protection and usage balance of the coastal areas could also ensure transition of the natural values to future generations. Trabzon city has been under severe urbanization problem for the last 30 years due to migration from rural to coastal areas of the city. It is thought that recently completed motorway and its service roads accelerated the urbanization on coastal periphery. Therefore, the problem must be resolved as soon as possible to achieve the good environmental status of the coast in the city. Thus, as a solution, DPSIR framework was proposed for systematic evaluation and documentation of the related critical issues by starting with a questionnaire composed of open ended questions for determination of major coastal problems in the city. As a step forward, the problems are quantitatively investigated and confirmed by using remote sensing techniques and census data compiled from TUIK databases. As a result major drivers were defined as "coastal urbanization", "coastal land filling" and "coastal transportation" for the city of Trabzon. It is recommended that single authority (composed of various specialists) must take the responsibility of coastal planning in the region. Moreover, the rights of the municipalities on the coastal zone must urgently be stopped by applying continues independent monitoring. Finally, taxation and land owning policies have to be revised on coastal areas to balance and encourage alternative city planning strategies.

Keywords: Coastal Zone, Ecology, Urbanization, Remote Sensing, Trabzon, Turkey

Introduction

Coasts have been always attractive and important places for human beings. Due to many economic and social causes, the interest and willingness for living by the coast has shown a rising trend in recent decades. However, the increasing trend of coastal living triggered many unwanted problems such as urban sprawl and unplanned fast urbanization. Coasts are places that supply economically valuable ecosystem services. Therefore, more than half of the world's economic activities occur in 100km wide coastal zone (Nobre, 2011). Unfortunately, the attractiveness and very high interest in coastal zones have led to coastal degradation in many places of the world seas. These can be noticed as deterioration of natural habitats, decreasing rate of biodiversity and rising vulnerability of the coastal areas regarding global climate change (Nobre, 2011).

Coasts are valuable and unique areas with rich biodiversity where land and sea ecosystems meet and create a transitional living interface. Coastal zones that are used for transportation, settlement and recreational activities for many years are mainly shaped by physical forces. The change is a dynamic in nature and can be either natural or artificial according to root causes involved in the process. The change may become more apparent under the effects of circulations, waves, tides and interactions with the bottom topography (Dronker, 2005). As it can observed in other countries of the world, Turkey's natural coastal morphology greatly altered by artificial or man-made structures which cause some fundamental and long-lasting defects in coastal zones. The willingness to live by the sea has created overuse stress on the coasts (Gazioğlu, et al., 1997). This situation is obviously noticed as urban sprawl and very dense urbanization on coastal areas (Palmer, 2011).

In order to balance human induced pressure on coastal zones, an ecosystem based planning and design is inevitable. Especially for the recent 20-25 years time span, there is a tendency in communities to return back to nature and natural life styles which should be seriously taken in to account during the feasibility phases of the planning projects including landscape planning and building. These type of designs are expected to be more sustainable and usable compared to those on site designs ignoring ecological principals. Ecosystem based landscape design account for not only natural factors but also sociological and cultural textures of the planning area (Cengiz, 2012). These techniques are also important in terms of using both ecology and planning together (Antrop, 2001).

Furthermore, as a candidate country Turkey should also consider the regulations and amendments of EU treaties such as European Landscape Convention (Council of Europe, 2000) and Natura-2000 (Özüdoğru and Duygu, 2009) when taking decisions or planning the coastal environment. Following such multi-part agreements can also improve the possibility of having and developing eco-friendly management perspectives of the country.

Human induced changes on natural land cover types are much more catastrophic on places such as coasts, which are under very high stress of urbanization effect (Cengiz, 2012). The most important changes among all are the fragmentation of green coverage and loss of biodiversity in coastal zones (Ahern, 1995; Güneroğlu et al., 2013; Güneroğlu et al., 2015; Güneroğlu, 2015). The situation has no exception for Southern Black Sea coasts. Recently completed Black Sea coastal motorway and its complementary road network towards inner regions has greatly altered the natural texture of the coastal zone especially on eastern side of the region. Therefore following an ecosystem based planning becomes an important requirement when designing the coastal zone of the region. It is clear that ecosystem services availability and continuity should have as much as attention in order to design a sustainable environment.

Ecosystem based coastal landscape design should account for many technical details and techniques. The first principal that should be embedded in to the coastal design project is the construction of a buffer zone between the sea and land spaces. These zones can be designed for protection or vegetation of the area (Stewart et al., 2003). Another principal that must be considered in coastal landscape design is to connect the patches to create continuity and unity of the interested area. In this manner, green way or green corridor design techniques can be followed to reach visual, functional, ecological and recreational spaces or green networks on the coastal niches (Ahern, 1995; Linehan et.al, 1995; Arendt, 2004; Güneroğlu et al., 2013). Five fundamental functions should be envisaged during the design phase of the projects. These functions can be summarized as establishing the linearity, connection of the patches, multi-functionality, sustainability based on usage and protection perspective and protection of natural and cultural landscape values (Ahern, 1995).

Eventhough, landscape change is inevitable due to natural and cultural impacts, such changes must be always enhancing the ecosystem and unity of the governing elements (Antrop, 2005). Therefore, during the urban renewal or designing projects protecting the ecological integrity should come at first stage. From that perspective, changes of the landscapes should be in a positive way by adding value by protecting the landscape identity and improving the ecological state. Protection of the available landscapes is also stressed in European Landscape Convention. Unfortunately, due to administration complexity and different authorizations on management of the coastal areas, the situation is getting worse in Turkey. The need for a single authority has become a priority; such an authority should not share its authorization with author actors but the knowledge and data on coastal management.

The major factors influencing the landscape of a region are mainly urbanization, globalization and transportation networks as well as some unexpected natural phenomenon such as hurricanes or earthquakes (Antrop, 2005). Under such circumstances, the change in landscape is generally not recoverable. Thus, planning of the coastal areas holds a special part of the landscape design philosophy.

In North Eastern part of Turkey especially after completion of the Black Sea motorway project, abrupt changes have been observed on coastal morphology with very dense urbanization problems. The causes and effects of such changes should be carefully investigated to have some future projections and plans for the region (Akkaya et al., 1998). Similar changes were also noticed in southern coastal regions for instance the fragmentation of natural coastal landscape of Mersin-Erdemli (Alphan and Çelik, 2016). In this study, the coastal urbanization and LULC changes were investigated with special emphasize on migration from rural to urban in Trabzon city.

Materials and Method

Study Area

The city of Trabzon is one of the oldest and historical cities of the Black Sea region. Many civilizations thorough the history have occupied and lived in the coastal vicinity of the city (Figure 1). The city is geographically bordered by the Black Sea from the north, Gümüşhane from the south, Rize from the east and Giresun from the west side. The city including the centre has ten counties located on the coastal zone. The importance of the city mainly depends on history, because ancient silk way routes have connections to the inner Anatolian regions through the city of Trabzon (Kadıoğlu, 2011; Güneroğlu, 2015).

The natural geography and very steep mountain morphology of the region triggered the linear littoral settlement along the coast in North Eastern part of Turkey (Yüce and Gazioğlu, 2006; Güneroğlu et al., 2013). The migration trend started at the beginnings of 1950s accelerated the movement of the people from rural to urbanized areas by the coast. Consequently, urban sprawl and very dense and fast urbanization created an extra stress on the city of Trabzon. City plans prepared in 1938 and 1970 were not meet the requirements of the city in terms of development and necessary infrastructures (Kadıoğlu, 2011; Simav et al., 2015).

Therefore, land cover types such as agricultural lands and green vegetated areas were transformed to impervious surfaces (Güneroğlu, 2015). The possible causes of the land cover changes can be attributed to recently completed Black Sea motor way and its complementary service road networks.

DPSIR Framework

The coastal zone of the city has greatly suffered from the coastal passage of the motorway after 2007. Therefore, it became an issue of high priority to investigate the stakeholders' opinion about how the Black Sea motorway affected some services such as tourism, transportation, urbanization and recreational usage in the region. Open ended questionnaire was designed to determine the main drivers or stressors by directing the questions to stakeholders living in the region. In order to compile related information on main stressors, an analytical DPSIR (Driver – Pressure – State – Impact - Response) framework was used. The DPSIR framework was first used by Rapport and Friend (1979) as "stress-response" method to solve some environmental related problems and modified to its most recent form by OECD (Rapport and Friend, 1979; OECD, 1993; Atkins, et al.,2011; Pirrone et al., 2005). DPSIR technique is an effective tool for researching of the environmental problems considering the sustainability of the ecosystem (Borja et al., 2006). Contextually, driving forces of the approach can be related to socio economic conditions reflected to the daily routines, surrounding environment and its policies. For instance, very dense urbanization stress can cause the loss of vegetation cover and may turns to visual and ecological degradation of the coastal habitats. It is clear that such an incidence can create unwanted results for example exceeding the overall carrying capacity of the ecosystem, thus all related responses must be received in order to eliminate any negative impacts.

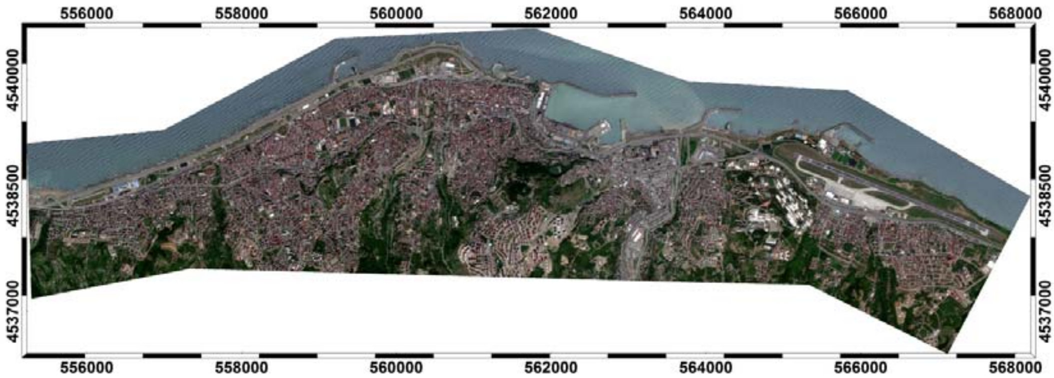

Fig., 1. Study area

Detailed literature review and applied questionnaires revealed the hot topics or priorities of the Trabzon coastal city. There are mainly three important topics, which can be summarized as follow;

- Coastal very dense urbanization
- Coastal transportation
- Usage of coastal landfill areas
-

Urbanization can be defined as accelerated increasing trend in urban population compared to rural population in definite period of time (Pantelic et al., 2007; Baird, 2009). Therefore the urbanization rate is linked to movement of the population from one place to another and can be followed by analyzing the census data. The movement can occur among intercity or can be simply in the same city from rural side to urban or coastal side. The case of the Trabzon city can be described with the latter one.

Satellite Data

Analyzing the urbanization rate using satellite data is important in terms of establishing more robust and quantitative solutions to the problem. Therefore, Landsat 5 TM (acquired on 01 August 1985, Landsat 8 LDCM (acquired on 14 June 2014) and Worldview 2 (acquired on 14 July 2014) multispectral satellite images were used during the analysis. Especially very high-resolution data from Worldview 2 was very effective in distinguishing asphalt covered transportation lanes of the inner city areas and showing the fragmentation rate of the urbanized regions. The entire satellite data was geometrically and atmospherically corrected images within form of the surface reflectances.
Producing LU/LC Data

In order to investigate long-term coastal changes in Trabzon city, satellite data was classified according to spatial and spectral resolution capabilities. Landsat TM and Landsat 8 satellite images were classified to 4 basic classes such as impervious surface (IS), Vegetation (V), Bare Soil and Agriculture (BSA) and Water (W). Similarly, Worldview 2 satellite image was classified by targeting the extraction of asphalt roads. Therefore, 5 classes were decided, these are Residential Areas (RA), Asphalt Roads (AR), Vegetation (V), Bare Soil and Agriculture (BSA) and Water (W). LULC maps were created by using surface reflectance values. The classification of satellite images completed by applying Support Vector Machine (SVM) algorithm, which is recently proved to be very effective in separating non-linear features from remotely sensed images (Pal and Mather, 2005; Kavzoğlu and Colkesen, 2009; Duro et al., 2012; Dihkan et al., 2013).

Producing Training and Test Datasets

A field survey was carried out to collect necessary data that will be used during the pixel based classification for training and testing the classifier. Mather (2004) reported that, during the training process the minimum number of the necessary sample pixels could be 30 times more than each feature class. Field data sampling was carried out following the Mather (2004) recommendations. Then, stratified random sampling method was used to separate training and test data. 60% of the field data is used for training purposes whereas the remaining 40% was separated for testing.

Classification Process Using Support Vector Machine (SVM) Algorithm

SVM is a non-parametric supervised classification algorithm that is capable of separating classes using optimum hyperplanes by verifying their generalization capabilities (Vapnik, 2000). The algorithm uses training dataset during the plane separation and verification process. In the study, training dataset prepared for all images was used to train the SVM algorithm and applying the classification of multidimensional datasets of surface reflectance images. As a further step, LULC classes were determined from classified data. Some morphologic operations were applied at the final stage to eliminate noisy pixels and produce final LULC images. Classified satellite images (Landsat and Worldview) for 1985 and 2014 were given in Figure 2 and 3.

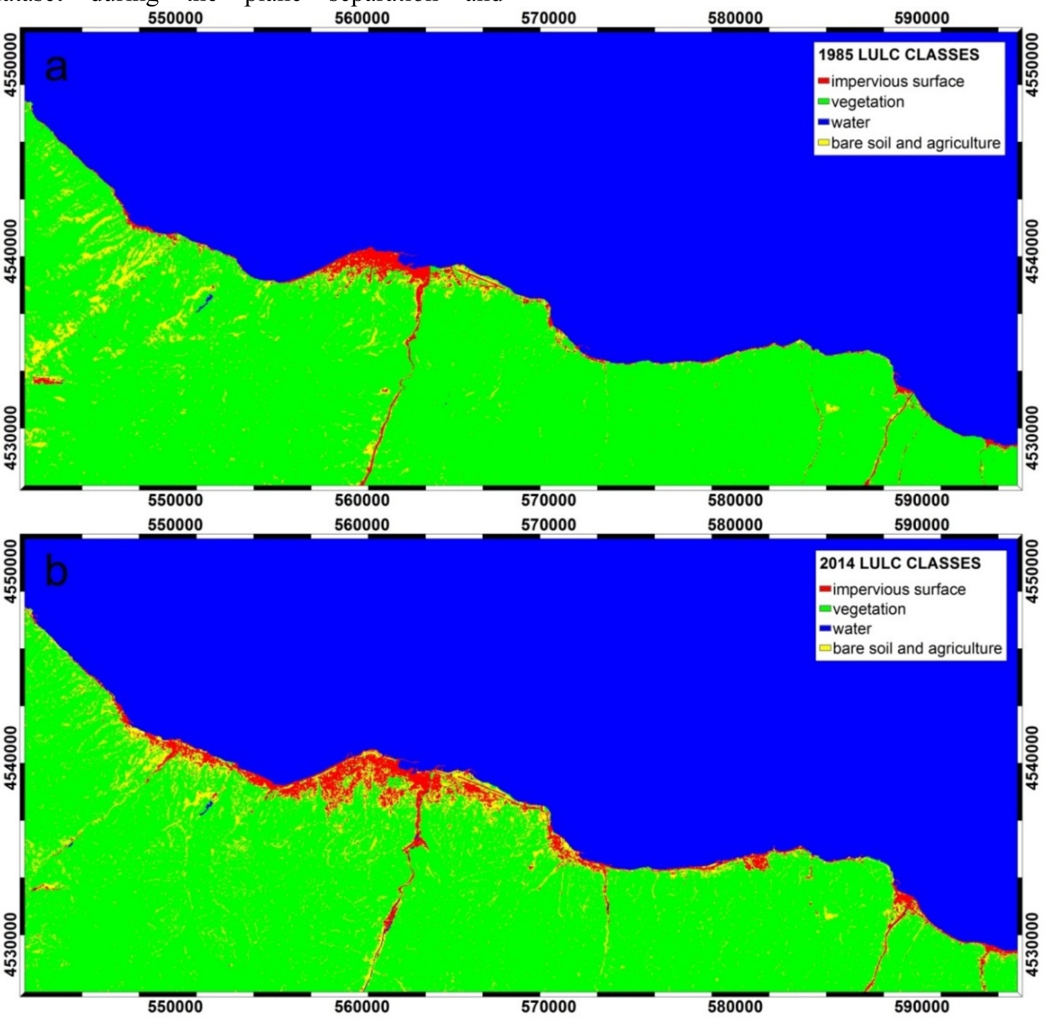

Fig. 2. LULC maps produced from Landsat TM satellite data a) 1984 and b) 2014

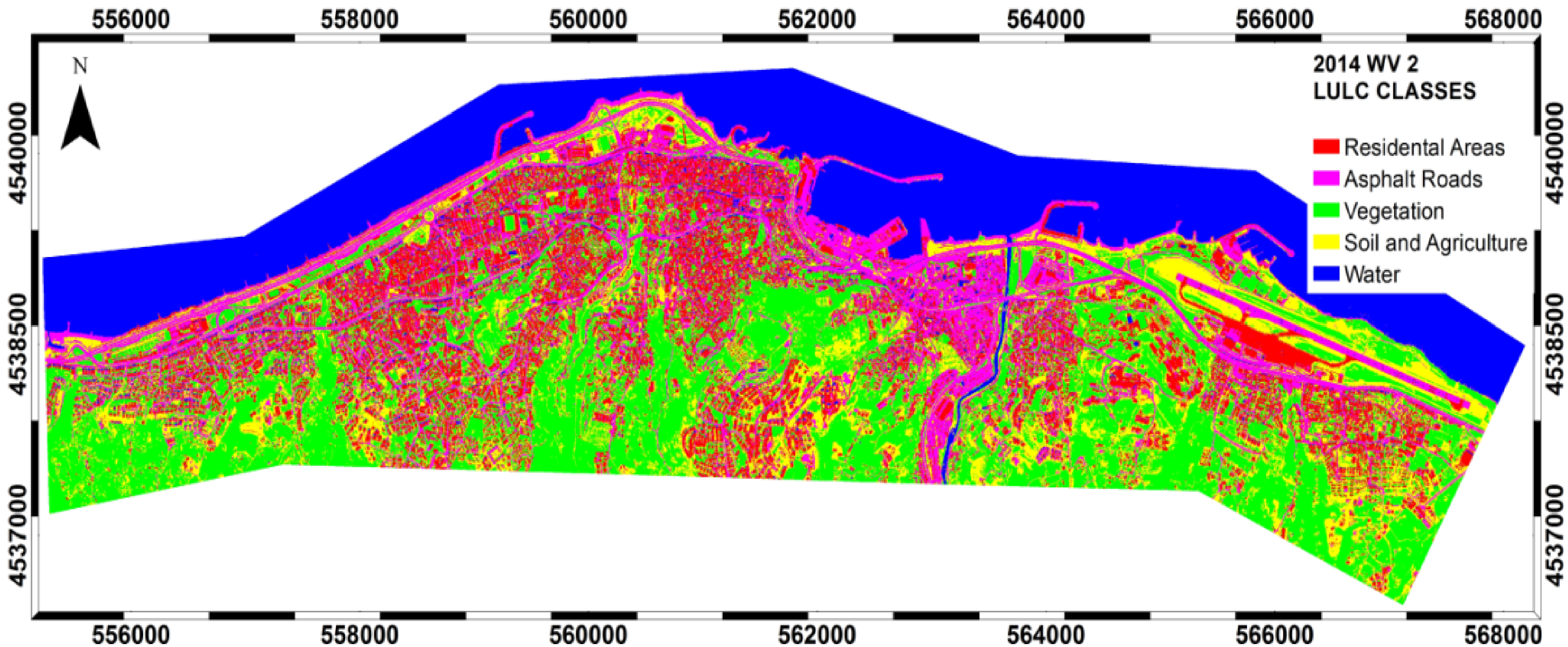

Fig. 3. LULC map produced from Worldview 2 multispectral satellite data

Accuracy Assessment of Classification Process

Accuracy assessment analyses were done by calculating error matrices comparing classification results with test data from field survey (Table 1 and 2). Some accuracy metrics such as Overall Accuracy (Oa), Kappa, User Accuracy (Ua) and Producer Accuracy (Pa) were calculated as shown in Table 1 and 2. Analyzing the accuracy metrics given in Table 1 and 2, it can be easily seen that the classification results yielded accurate and successful results for the study.

Table 1. Accuracy metrics for classified Landsat satellite data (IR: Impervious Surface, V: Vegetation, BSA: Bare Soil and Agriculture, W: Water)

SVM Classification Results Landsat TM / LDCM					
1985					
Classes (%)	***RA***	***V***	***BSA***	***W***	***Pa***
RA	97	0	4.9	0	97
V	0	100	0	0	100
BSA	2	0	95.1	0	95.1
W	1	0	0	100	100
Ua	95.1	100	97.98	99.16	
				Oa: 94.62	*Kappa:* 0.93
2014					
Classes (%)	***RA***	***V***	***BSA***	***W***	***Pa***
RA	97.22	0	8.82	0	97.22
V	0	98.08	2.94	0	98.08
BSA	2.78	0	88.24	0	88.24
W	0	1.92	0	100	100
Ua	92.11	97.14	96.77	98.06	98.10
				Oa: 98.10	*Kappa:* 0.97

Table 2. Accuracy metrics for classified Worldview 2 satellite data (RA: Residential Area, AR: Asphalt Roads V: Vegetation, BSA: Bare Soil and Agriculture, W: Water)

SVM Classification Results Worldview 2						
2014						
Classes (%)	***RA***	***AR***	***BSA***	***V***	***W***	***Pa***
RA	81	2.86	1.98	0	0	81
AR	13	97.14	0	0	0.97	97.14
BSA	5	0	98.02	3	0	98.02
V	0	0	0	97	0	97
W	1	0	0	0	99.03	99.03
Ua	94.19	87.93	92.52	100	99.03	94.50
				Oa: 94.50	*Kappa:* 0.93	

As shown in Table 3 below population increase in some major coastal settlements of Trabzon city is given for the last 50 years. The census data was compiled from the TUIK databases and it is a good indicator for showing the migration stress on coastal zone or the rate of urbanization.

Table 3. Census data for major coastal settlements of Trabzon (URL_1).

Years	1965	1975	1980	1985	1990	2014*
City Central	65516	97210	108403	142008	143941	314246
Akyazı	1509	1748	1857	1881	2061	2541
Beşirli	1454	1881	2782	3855	5492	24486
Bostancı	881	1208	2131	4108	2773	4666
Çimenli	719	1105	1120	1220	1268	1809
Konaklar	319	627	1004	1207	1680	4130
Pelitli	425	792	1660	2389	3139	15755
Yalıncak	1002	1512	1535	1895	2286	3718
Kaşüstü	1637	2029	2209	2416	2627	6313
City Total	**595782**	**719008**	**731045**	**786194**	**795849**	**766782**

*The census statistics are based on registered residential adress.

According to Table 3 given above, approximately 10 folds increase could be observed in coastal places such as Beşirli, Pelitli, Konaklar and Kaşüstü. Data for 1965, 1975, 1985 and 1990 was based on general survey results of the census data whereas the year of 2014 statistics was from address based registered census data. Qualitative comparison of census data with classified satellite images revealed confirmative results as it can be seen the rate of impervious surface has greatly covered the coastal zone of the city for the last 30 decades. Kaşüstü, Beşirli and Yalıncak are still primary areas of the construction market in Trabzon. Interestingly, people living in the rural areas are also willing to move to those newly built compounds or luxury living areas.

Results and Discussion

Human induced recent changes on coastal zone of Trabzon city have greatly altered the overall environmental quality in negative direction. City plans that are expected to account for city development type and its settlement axis are failed to meet the needs of the Trabzon city in the last decades. Furthermore, population increase in some coastal sites has exceeded the limits, the growth rate is more than 3 fold today when compared to 1965 census data. This can be attributed to anthropogenic stress on coastal zone. Some palliative solutions are still considered for the coastal areas suffered from urbanization. One of those solutions is a well-known and highly experienced in the region. Even though it is an expensive and devastating process, "landfill" is still a fashion engineering practice in the region. The aim is to extend the coastal area by filling it but considering the long-term sustainability and ecosystem health of the coastal vicinity, the applied methodology is not appropriate and eco-friendly solution. Moreover, institutional complexity of the coastal law creates some unwanted management application mainly implemented and permitted by the local municipalities.

Visual inspection of the Figure 3 has shown that service roads that connect the main motorway to the city center surround the all city like a network, which is a strong sign of the urbanization of the area. Although the recently completed Black Sea coastal motorway has facilitated the transportation from Europe to Caucasian regions, it is clear that this newly built road stands as a barrier between humans and the sea by limiting the access for recreational usage of the coast. Dense urbanization of the city has also caused some problems in dissemination of the infrastructure services. This problem is mainly related to the steep morphological character of the city topography (Kadıoğlu, 2011). This is also a negative factor that affects the ecological connectivity in the city. The fragmentation level is so high that planning new green corridors for the city is an issue of high priority to recover the urban ecosystem. Another problem that comes in to agenda is the environmental pollution caused by motor vehicles using this very intense road networks. Atmospheric air quality is highly degraded in some hotspots of the city by adding the fossil fuels burning especially in winter seasons.

Evaluating the entire city with its coastal counties including the center, similar problems can be observed in the region. The dense coastal urbanization can also adversely affect the coastal marine ecosystems via interactions of the both ecosystems. Such negative impacts could be devastating such as very high recreational usage that exceeds the ecological carrying capacity or inadequate sewer systems in the coastal zone (Burak et al., 2004; Gazioğlu et al., 2016).

For the last 30 years the impervious surface of the city LU/LC has dramatically increased. The situation is clearly shown in Figure 2 by comparing 1965's satellite image to 2014. In this period the rural populations of the Trabzon city has migrated to city center and coastal areas with the hope living a high quality and comfortable life. Therefore the problems indicated in DPSIR Table 4 are real experienced and coincide with the migration story of the city. Furthermore, the quantitative changes of the LULC structure are given in Table 5.

Table 4. DPSIR framework for coastal city of Trabzon

Drivers	Pressures	State	Impact	Response
Coastal urbanization	Removal of the green coverage Increasing percentage of impervious surfaces Devastating the natural coastal formation	Decreased vegetation Limited connectivity to the beach Fragmented ugly landscapes	Exceeded environmental carrying capacity Decreasing tourism potential Decreasing privacy Loss of naturalness Rising risk of environmental pollution	Designating no built-up zones on the coast Rising and setting up new tax policies Planing alternative city development scenarios Creating focal attraction points on southern side
Coastal transportation	Fragmentation of the coastal landscape Environmental pollution	Over populated areas Deteriorated ecological links High atmospheric pollution	Congestion and crowded habitats Uncomfortable environment Health and mental problems Inadequate infrastructure	Planning alternative routes for intercity highway Reducing air pollution by low traffic waiting time Designing green filters by appropriate planting design
Coastal landfill	Devastating coastal habitats Creating pollution Attract different investments	Loss of coastal biodiversity Increasing risk of contamination Altered landscapes	Unsustainable environment Polluted beaches and coasts Decreasing number of species Low visual quality	Implementing current regulations and on site monitoring of the ecological state Stop municipal authorization on coastal zone Active and effective state control mechanisms

Table 5. Rational changes of LULC maps between 1984 and 2014

Percentages	1985 (imp_surface)	1985 (vegetation)	1985 (soil_agr)	1985 (water)	Row Total	Class Total
2014 (imp_surface)	55.522	0.513	7.72	0.292	100	100
2014 (veg)	14.268	96.835	63.4	0.813	100	100
2014 (soil_and_agr)	22.653	2.586	28.37	0.111	100	100
2014 (water)	7.557	0.066	0.51	98.784	100	100
Class Total	100	100	100	100	0	0
Class Changes	44.478	3.165	71.63	1.216	0	0
Image Difference	51.936	-0.57	34.32	-1.036	0	0

Area (Square Km)	1985 (imp_surface)	1985 (vegetation)	1985 (soil_agr)	1985 (water)	Row Total	Class Total
2014 (imp_surface)	16.5969	15.0975	6.2451	7.4781	45.4176	45.4176
2014 (veg)	4.2651	2849.6466	51.2892	20.7855	2925.9864	2925.9864
2014 (soil_and_agr)	6.7716	76.0896	22.9509	2.8494	108.6615	108.6615
2014 (water)	2.259	1.9386	0.4122	2527.0776	2531.6874	2531.6874
Class Total	29.8926	2942.7723	80.8974	2558.1906	0	0
Class Changes	13.2957	93.1257	57.9465	31.113	0	0
Image Difference	15.525	-16.7859	27.7641	-26.5032	0	0

According to Table 5 the impervious surface has increased 52% which is around 15.53 km^2 expansion of the cover. On the contrary, the green vegetation cover has decreased approximately 16.79 km^2 which is an important indicator of the urbanization of the city. It might be expected that such an increase in impervious surface cover may lead to floods or storm surge problems in the city, as it will limit the permeability of the land, especially in areas with relatively low slope rate. These unwanted problems may increase in both occurrence frequency and power in future. It is also clear that the storm surge waters will be transferred to coastal waters with high load of heavy metals, organic pollutants and other degraded materials. An eutrophication or anoxia can develop in coastal waters of the city that are serious environmental problems causing degradation of water quality and usage. It can also be inferred from the Table 5 that agricultural land cover type has also increased in the last 30 years which can be attributed to the inherit habits of the migrants from rural to center to continue their agricultural practices in the central region. Unfortunately, this is also problematic situation for the region due to usage of fertilizers that are washed off by the rain waters to the sea.

Transportation facilities are basic needs of the daily life provided that they suit with environmental assests of the ecosystem. If this rule is omitted then the transportation projects are tend to be inadequate in meeting short and long-term requirements of the city and the overall results could be a failure. Especially, at this stage decision makers must be very serious on implementing the governing laws and regulations. Any violation or omission of the law may create unwanted results on the coastal environment. For instance, after completion of the Black Sea motorway in 2007, there were no any issued licenses on international highway periphery due to the safety and security. Nevertheless, later on the municipalities started issuing and permitting commercial licenses just on the coastline such as cafes and restaurants, which can be a kind of rolling back the situation to 30 years ago on the coastal zone. The municipalities must take in to account all facilities of such establishments for example, necessary infrastructure, and electricity, water and sewer systems. Otherwise environmental degradation is inevitable as Lee et al.(2006) reports that urbanization effects could be severe on wetlands and coastal ecosystems by diminishing ecological connectivity and environmental quality.

Another solution of restraining urbanization on the coastal zone can be make necessary changes in issue of new building licenses and construction law enforcement. Construction regulations must be altered in favor of the coastal ecosystem quality. Therefore, a single authority is suggested to avoid institutional crowd when issuing licenses for any commercial or general activity on coastal zone including recreational activity areas suggested by local municipalities' revision plans. Designating no built-up zones in coastal zone is another priority to protect the coastal ecosystem health in the region.

Furthermore, the taxation regime of the current law in force can be modified by pushing up the taxes for those settling on the coastal periphery to make some people avoiding buying or building new houses by the sea.

Planning alternative city development plans could another alternative solution of the coastal urbanization problem in the region. The city should stop expanding in linear littoral form by using north-south axis for new settlements projects. This can be also beneficial for the rural side people in terms of socio economic and cultural developments as well as diminishing the urbanization stress on the coastal zone. New focal centers can be designed to attract the people for living in those areas. Moreover, green linear planting may help to reduce the traffic caused pollution by absorbing the exhaust emissions (Acar and Güneroğlu, 2009). Finding solution for municipality rights in management of the coastal zone must be seriously resolved in the city as today's coastal urbanization problem is mainly triggered by the local applications of the municipalities. Licensing new constructions on the coastal section of the city must be stopped otherwise coastal areas will continue to be attractive for new comers. Suggested single authority must take the full responsibility with carefully formed multidisciplinary decision makers team with an option to be controlled by independent bodies.

Conclusion

Stopping the human willingness of living by the coast is not expected to be realized. But planning, designing and using the coastal regions in sustainable manner could be achieved provided that ecosystem based approaches are implemented by considering all coastal management stake holders. At this stage, the coastal management problem turns to be an optimization issue to be solved by environmentalists including engineers, designers and planners. The government must take the full responsibility in solving the coastal urbanization issue in Trabzon city including revision of private property rights on the coastal zone. The urbanization stress on the coastal zone of the city must be stopped as soon as possible to create eco-friendly sustainable environments for the future generations.

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