THE INVESTIGATION OF THE RELATION BETWEEN NDVI IMAGE AND FOREST MANAGEMENT-SITE INDEX DATA, THE CASE OF BARTIN REGION OF FORESTRY, TURKEY

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Abstract: Site index is defined as the power of product and service production of somewhere. However, a forested land has actual and potential efficiency power. In the application, it is the actual site index we have determined according to several criteria. Actual situation is far from reflecting the real efficiency. The stand could have been affected negatively from various factors. The common structure seen in Turkey forests is like that. When the real situation is demanded, it is necessary to identify the potential productivity. Within the scope of site index term, site indicators and indexes for productive stands have been determined and accepted. We have sufficient information about these. However, the subject of making disordered stands and clearings is site index hasn't been clarified. The site index of the areas in inventory studies increasing the cost are assigned using age-length data of the trees. However, this method does not provide sufficient accuracy for someone examining the area in separation of the site classes. Inferences have been made related to actual and potential site index by comparing NDVI images through satellite image data for the study area of which site index maps have been decided in the study and the relations have been searched. Actual and potential site index thematic maps have been formed for the sample study area through NDVI image data as the final outcome.

Keywords: Forestry, NDVI, Remote sensing data, Site index

Introduction

Bonitet is defined as the products and service production power of a place. The field has actual and potential efficiency power. In practice, it is the actual bonitet we determine according to various criteria. Actual case may be far from reflecting the true yield potential. Existing stand might be affected by several factors negatively. Actual and potential efficiency can differently emerge very dramatically. Potential efficiency is the efficiency that will be obtained if a stand is found in the normal setup that the field can exploit the real efficiency power and collect on it. The difference between the actual and potential efficiency increases with the rate of the existing stand gets away from the normal setup. Bonitet concept, bonitet indicators and indices are determined for efficient stands and have been accepted. However, in the boniteting the disordered stands and opening areas, the subject has not been clarified. In some places, the cases that is conflicting to the knowns may be found structurally. There may be situations that this contradiction cannot be even explained by the soil structure or the plants nutrients inside the soil (Eler, 2002; URL 1).

Site index is based on the quite different projections of the site in near infrared and visible red bands. A healthy site absorbs the visible light reflects most of the near infrared light, on the other hand, a sick/unhealthy site reflects the visible light more and the near infrared less. Reflection in the visible bands depends on the pigments in plant leaves, while it depends on the plant cell structure in near infrared region (Baker, 1987). The most widely used index in the Normalized Difference Vegetation Index. The algorithm of the Normalized Difference Vegetation Index is given as;

$$\text{Normalized Difference Vegetation Index} = \frac{\text{Near Infrared} - \text{Red}}{\text{Near Infrared} + \text{Red}}$$

The results vary between -1 to +1 depending on the situation of the area where the site is located. For example, if the obtained value if 0,1 or lower, it corresponds to rocky areas, between 0,2 to 0,3 it will be meadow or grass; for 0,6 to 0,8 it corresponds to a healthy site (Akkartal et al., 2005).
In this study, for the study area whose bonitet maps are determined, the findings and the realtionships related to the actual and potential Bonite are investigated by comparing NDVI images over the satellite images. As a resulting product, actual and potential bonitet thematic maps are formed for the sample area over NDVI image data.

Materials and Methods

The field of study is located between 32º 06' 43" and 32º 45' 39" East longitude and 41º 34'33" and 41º 50' 31" North latitude in the Western Black Sea Region in Turkey. The total area is covered by forest community (*Quercus sp.,Carpinus betulus, Castenae sativa, Fagus orientalis, Pinus sylvestris, Pinus nigra, Abies bornmülleriana* are formed mixed forest) with the rest being pseudo-maquis land (Atesoglu and Tunay, 2010) (Figure 1). The land, deeply fragmented by the River of Bartın, and its branches has a rough appearance. There are narrow and deep valleys in the lands where the river gets wider and in between the quite steep slopes of the mountains.

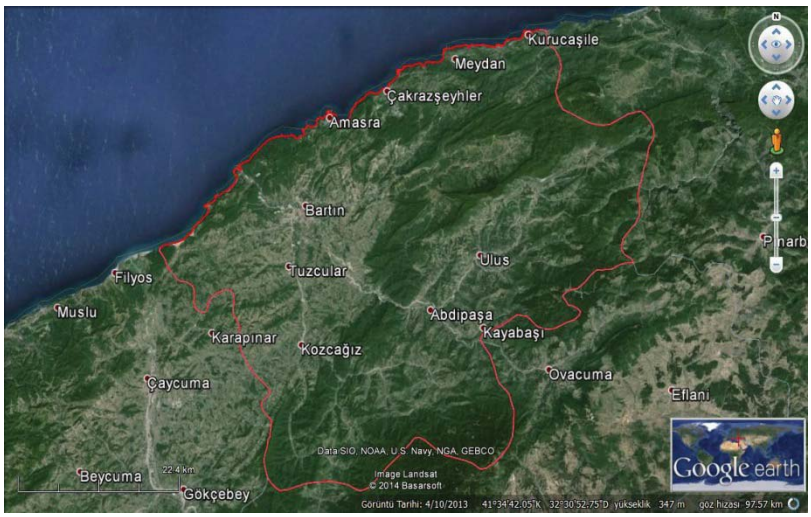


Figure 1. The field of study

Landsat TM satellite image data with different dates and whose geographical definition and geometric adjustment were made based on WGS 84 UTM 36N coordinate system were used in the study. Detailed information about Landsat satellite images can be obtained from Lillesand *et al.,* (2004).

The vegetation index image of satellite image data were formed in order to identify the land use according to the purpose of the study. Vegetation index is based on a quite different reflection of vegetation on near infrared and visible red bands. The vegetation index mostly used in practice is the Normalized Difference Vegetation Index (NDVI). The algorithm of NDVI is the ratio of the sum of the difference between near infrared band and red band. Classified result image data were formed from vegetation image data generated. In assessing RS data, the related modules of PCI EASI/PACE image processing software were used. Arc View 9.1 program, an ESRI software, was used for GIS practices.

As the method, a vegetation map created with the satellite images and a map made by using the management plan data of Bartin Forest Management Directorate are compared. Taking 0. Bonitet and 5. Bonitet in the management plan data as the basis, bonitet map is produced. With the help of NDVI from the satellite images, vegetation map is formed. In NDVI values, 0% areas are the areas without vegetation, areas having 0%-15% values are the areas having less dense vegetation, areas having 15%-65% values are the areas having the medium density of vegetation and the areas having more than 65% values are determined to be the areas with high density vegetation.

Results

With the help of the management plans, classification in which no vegetation is found within the border of the study area (Site indeks_0) is composed of 6 site index classes (Figure 2). Due to the lack of the areas with 1. And 2. Bonitets, these areas are combined. Actual case was determined in 2009 and the management plan is prepared in 2010.

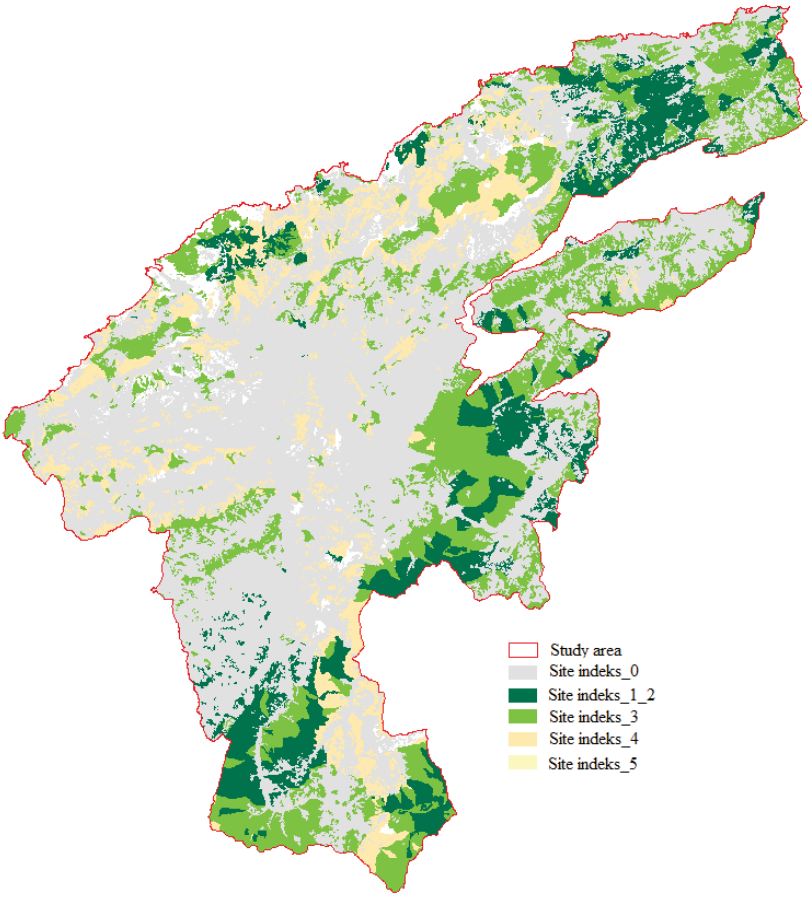


Figure 2. Bonitet Map

For the vegetation map obtained with the help of the satellite images; 0% NDVI corresponds to “no vegetation” areas, areas up to 15% are “low vegetation” ones, up to 65% are the “moderate vegetation” areas and the areas more than 65% are determined to be “high vegetation” areas (Figure 3).

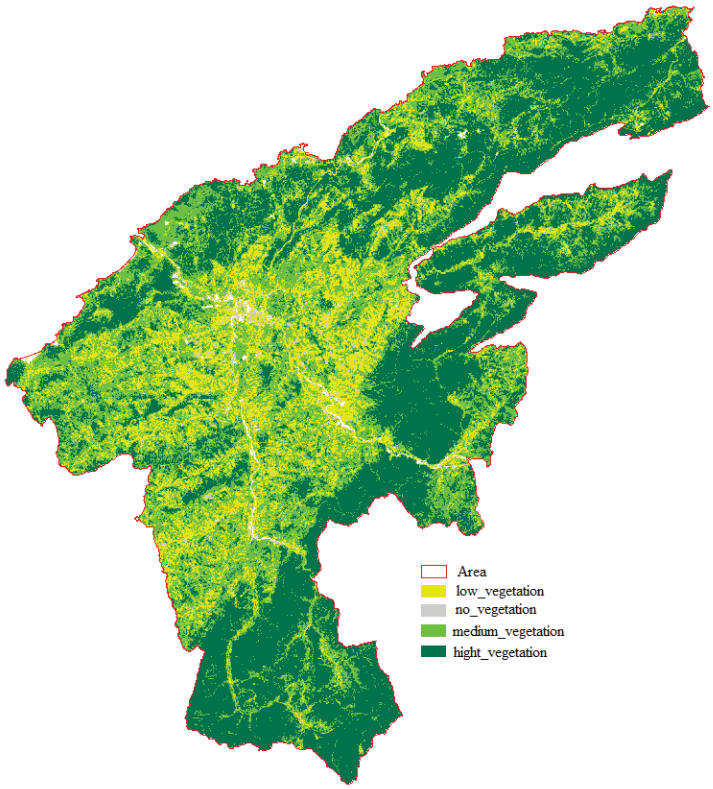
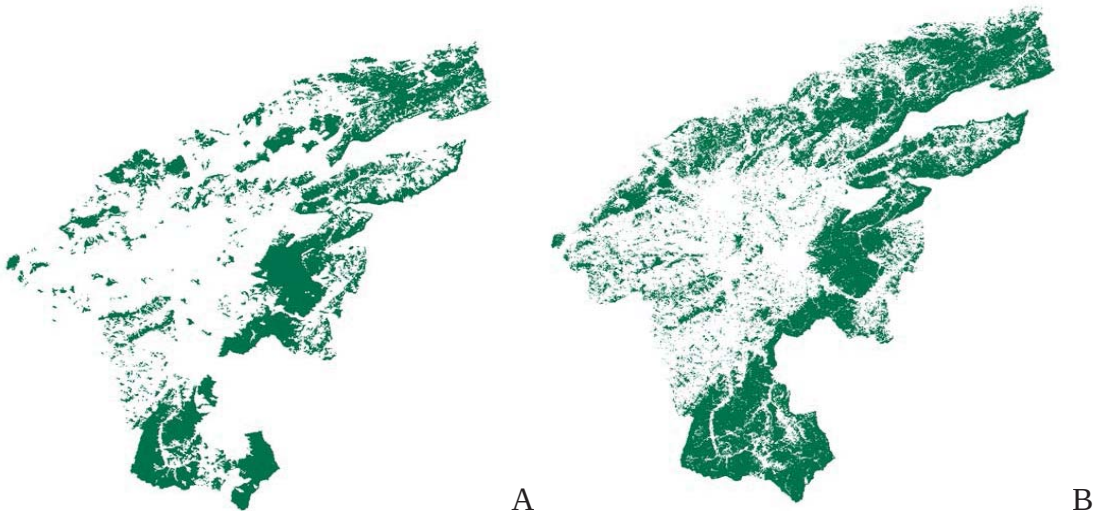


Figure 3. Vegetation Map

When two bonitet maps formed by using both satellite images and the management plan are investigated, the areas with "2" and "3" bonitets in the map made with the management plan are observed to overlap largely with the "high vegetation" areas formed with the help of satellite images (Figure 4).



A B

Figure 4. Areas with "2", "3" bonitet values according to the management plan (A); areas with "high vegetation" bonitet value according to the satellite images (B)

The map showing "0" bonitet areas made by taking the management plan as basis and the maps showing "no_vegetation" and "low_vegetation" areas with the help of the satellite images agree well in general. In addition, "medium-vegetation" areas are also observed partially to be coincide with the areas with "0" bonitet (Figure 5).

Furthermore, the areas "4" and "5" from the map made with the management plan are observed to be included in the "medium_vegetation" areas. When both maps are examined, differences are observed (Figure 6). The reason can be said to be that the management plan is constructed in 2010.

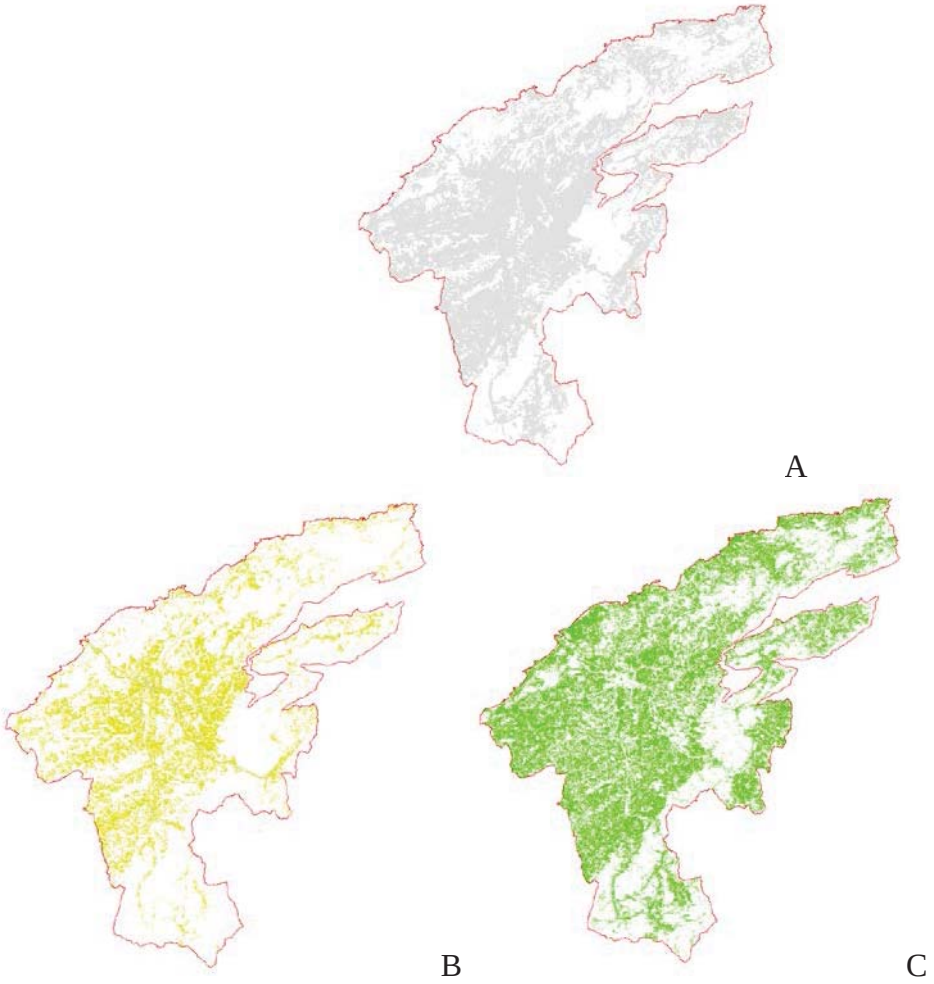


Figure 5. Areas having "0" boninet value according to the management plan (A); the areas with "no" (B), "low" (C) vegetation boninet values according to the satellite image

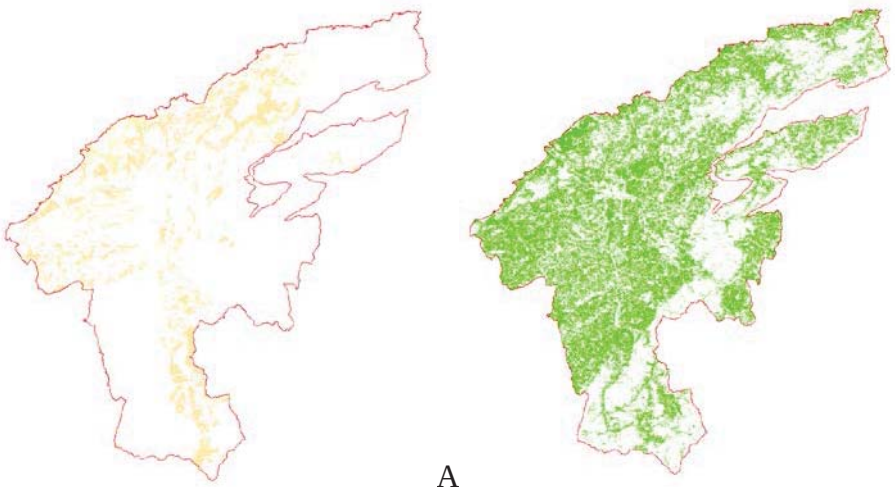


Figure 6. Areas having "4" and "5" boninet value according to the management plan (A); the areas with "medium" vegetation boninet values according to the satellite image (B)

Results

In NDVI maps, areas having 0% represent no vegetation, the ones with 15% represents to the areas with low vegetation, areas with 65% correspond to the moderate amount and the areas having 85% value represent the areas with dense vegetations.

Maps formed based on NDVI and Bonitet show conformity within the border of Bartın Forest Management Directorate, but there are differences when they are examined in detail. For example; the areas with no vegetation in the maps produced by NDVI are the areas with 0% value and no vegetation is found. On the other hand, the areas shown with "0" bonitet in Bonitet maps are thought to be inefficient areas and they might be thought as the areas without vegetation but in these areas, some degraded forest areas, agricultural areas can be seen. This means the vegetation existence in those areas even though it is individual.

As a result, it is shown that healthier bonitet classification can be made about the area by using satellite images instead of the management plan. It also helps to form the maps closer to the actual situation.

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