NWSA-Ecological Life Sciences
ISSN: 1306-3111/1308-7258
NWSA ID: 2014.9.1.5A0074

Status : Original Study
Received: July 2013
Accepted: January 2014

E-Journal of New World Sciences Academy

Atilla Atik
Bülent Yılmaz
Fürüzan Aslan
İnönü University, Malatya-Turkey
atikatilla@hotmail.com
bulent.yilmaz@inonu.edu.tr
furuzan.aslan@inonu.edu.tr

http://dx.doi.org/10.12739/NWSA.2014.9.1.5A0074

A STUDY ON THE DETERMINATION OF FACTORS EFFECTIVE ON FIBRE CHIP WOOD IN STATE FOREST MANAGEMENTS: THE SAMPLE OF BARTIN-GÜNYE FOREST MANAGEMENT

ABSTRACT

In the present study, factors affecting fibre-chip wood production are evaluated in the pure oriental beech (Fagus orientalis Lipsky.) forest in the sample of Bartın-Günye state forest Management. With this aim, 41 production units, included in the production program of the management between 2007 and 2010 and covering an area of 1277 ha, were chosen to be the study area. In the scope of the study, totally 22 variables were derived which were thought to be effective on the fibre chip wood production in the production units and related to the natural structure of production unit and formation of stand and their interactions. It was found from the multidimensional statistical analyses including principal component analysis and factor analysis that the most important factors effective on the production yield are "the stand site quality degree, aspect, slope, annual volume increment, actual basal area, elevation and average ground skidding distance".

Keywords: Fibre-Chip Wood, Production Rate, Factor Analysis, Discriminant Analysis, Bartın-Günye.

DEVLET ORMAN İŞLETMELERİNDE LİF-YONGA ODUNU ÜRETİMİNİ ETKİLEYEN FAKTÖRLERİN BELİRLENMESİ ÜZERİNE BİR ARAŞTIRMA: BARTIN-GÜNYE ORMAN İŞLETMESİ ÖRNEĞİ

ÖZET

Bu çalışmada Bartın-Günye Devlet Orman İşletmesi örneğinde, saf doğu kayını (Fagus orientalis Lipsky.) ormanlarında lif-yonga odunu üretimini etkileyen faktörler incelenmiştir. Bu amaçla ilgili şefliğin 2007-2010 yılları arasındaki üretim programında bulunan ve toplam 1277 ha alanı kaplayan 41 adet üretim birimi çalışma alanı olarak seçilmiştir. Üretim birimlerinde lif-yonga odunu üretim verimini etkilediği düşünülen, üretim biriminin doğal yapısı ve meşcere kuruluş yapısı durumu ile bunların birbirleriyle ilişkilerini ölçen 22 adet değişken geliştirilmiştir. Temel bileşenler ve faktör analizleri şeklinde uygulanan çok boyutlu istatistiksel analizler sonucunda verimi etkileyen en önemli faktörlerin; "bonitet, bakı, eğim, yıllık hacim artımı, aktüel göğüs yüzeyi alanı, rakım, ortalama sürütme mesafesi" olduğu saptanmıştır.

Anahtar Kelimeler: Lif-Yonga Odunu, Verim Yüzdesi, Faktör Analizi, Diskriminant Analizi, Bartın-Günye.

1. INTRODUCTION (GİRİŞ)

Rapid increase in the population and technological developments all over the world have changed the amount and form of demand for forest production and services [1 and 2]. When considered this huge demand in terms of good and service supplying, forest management should be evaluated to be an economic activity in addition to its biological and technical aspects and forest reserves are in the same way economical reserves [3]. Forests are natural reserves which should be taken globally into consideration with their functions such as provision of biological diversity, fresh water, clean air, recreational opportunities and erosion protection.

Forestry has turned out to be an important socio-economical sector which can create global employment and value addition since forests can supply an important economic raw material, wood, which is output of forest management sector and used to be main raw material or additives in 10 thousand different products, in addition to their functions which sustain suitable living conditions for any living organisms [4 and 5].

According to FAO data in 2011, global industrial roundwood removal is 1.58 billion m^3 $year^{-1}$, 0.9% of which Turkey accounts for (13.5 million m^3 $year^{-1}$ [6, 7 and 8].

According to the data obtained from Forest General Management of Turkey, which is responsible for the management of nearly all the forest areas in the country, amount of the yearly allowable cut in country's forests is 16.5 million m^3, which can give 13.6 million m^3 $year^{-1}$ wood raw materials. When the rates of products are taken into consideration for production types, fibre chip production is in the 2nd row with 23% after timber production and fibre chip is one of the wood raw material types for either its production amount or demand in the market [9].

Instead of massive wooden materials which are inefficient in both form and amount, the use of low valued wood raw material, whose form is changed technically and moulded in the forms needed meets the demand for wood raw material effectively and causes savings all over the world. Isotropic and homogenous chip plaque first began to be produced industrially in 1940s by removing industrial defects of natural wood. Remnants of wood industry such as preparatory cutting and annual plant stems with lingo cellulosic structure can be used with this aim. Chip and fibre plaque production turned out to be an important universal sector in the second half of the last century due to the diversity in products and use areas [10 and 11].

Unlike many European countries, nearly whole of Turkey's forests are natural characterized forests, which cover 27.5% of the surface area of the country. As it does all over the world, demand for forest products in Turkey consistently increases in spite of the increased number and amount of substitute goods, population increase, new development in technology and increased number of sectors needing wood raw materials. Demand for fibre-chip wood also increases depending similarly on the increase in the demand for fibre and chip plaque.

Fibre-chip production standards set by Forest General Management of Turkey, the largest producer of wood raw material in the country, are that the diameter of thin tip is 4 to 20 cm, length is 0.50, 1.00, 1.50 and 2.00 m. According to the same standards, fissure in fibre-chip wood, fibre curve, twin alburnum, eccentric growth, wounds and knob are the acceptable defects while carious trunk, cavity, curvature degree above 10%, tumour and fissure formation are unacceptable defect types [7 and 9].

Forestry sector deals with the management of a biological entity which is wholly open to natural conditions and whose development

depends on several geographical, edaphic and climatic factors [12]. Production yield of fibre-chip wood, one of the most important industrial wood types may be affected by natural structure of production unit and forest location.

Production plans of Turkish State Forest Management, responsible institute for the conservation and the management of forest reserves in the country include a 10 – year period. In a management plan rate of total wood material intended to be removed is divided by the time period of eta plan (10 year). However, due to the differences in nature and production devices amount of wood material may be different even though the yearly eta may be the same. This situation may cause great differences on yearly base in the rate of wood material sullied to the market. Fluctuation caused by market supply in a unit time interval can cause instability in price and mistakes in accumulation and storage plans of managements and yearly income estimations.

In the present study, four – year data about fibre-chip wood production obtained from the production units of Bartın-Günye State Forest Management were evaluated considering natural structure of the units and forest location features. Multidimensional statistical analyses were conducted to determine the effects of factors thought to be effective on production yield of fibre-chip wood produced in unit area using data obtained from the area. It was also targeted in the study to develop a model for which can be used for the accurate and applicable yield rate estimation and to contribute to the more sensitive and realistic planning works.

2. RESEARCH SIGNIFICANCE (ÇALIŞMANIN ÖNEMİ)

Knowledge of the number of facilities processing fibre-chip wood, capacity increase rate of present facilities and the fibre-chip wood production capacity of forests are important market parameters for demand and supply and import and export balances. This study is important for wood processing facilities to make their accurate and sensitive production plans by considering the most important factors affecting fibre-chip wood production in oriental beech and determined using a multi-facet approach.

With this aim, 41 production units, included in the production program of the Günye Forest Management located in West Blacksea Region of Turkey between 2007 and 2010 and covering an area of 1277 ha, were chosen to be the study area. Totally 22 variables were determined which are thought to be effective on production yield of fibre-chip wood in production units and show the relationship between natural structure of production units and stand location. It was found from the multidimensional statistical analyses including principal component analysis and factor analysis that the most important factors effective on the production yield are stand site quality degree, aspect, slope, annual volume increment, actual basal area, elevation, average ground skidding distance. Production units were divided into three categories using discriminate analysis considering percentage of fibre-chip wood yield and 22 variables. From the results, it was aimed for forest managements to estimate more accurately their annual fibre-chip wood production using methods and analyses used in the present study by considering it a model study.

3. MATERIALS AND METHODS (MATERYAL VE YÖNTEM)

The study area and data; study was conducted over 41 production units covering an area of 1277 ha in Bartın-Günye Forest management and included in 4 – year investment program. Production labours were supplied by the same cooperative. Fibre chip wood material was carried to loading ramp by skidding and rolling.

Günye Forest management (41°33'00"-41°21'00"N, and 32°14'30"-32°22'30"E) is in Western Black Sea Region of Turkey (Figure 1). Data about production units were obtained from management plans (2001-2010; 2011-2020), production records and the results of field measurements and observations [13 and 14]. GIS was also used as tool to obtain some data.

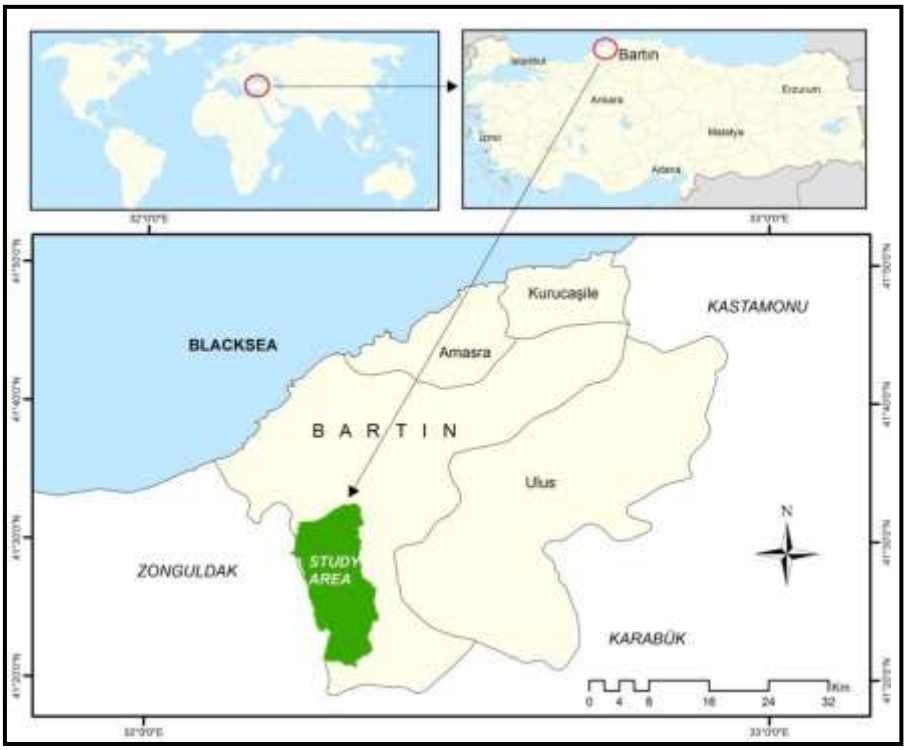

Figure 1. Location of the study area
(Şekil 1. Çalışma alanının konumu)

Climatic data was obtained form a meteorological station in Bartın 15.4 km away from the study area. According to the data of the Bartın Meteorology Station, at an altitude of 33 m, mean annual, minimum and maximum temperature values are 12.6°C, 0.3°C and 18.8°C, respectively while mean annual precipitation is 1035 mm [15]. Vegetation period in the area is between April (11.1°C) and October (13.6°C; totally seven months). Rainfall during the vegetation period is 527 mm. When the meteorological data is evaluated according to Thornthwaite method, it can be determined that the area has a climate type indicated by B_2B_1'rb4' symbols which means a location showing characteristics similar to oceanic climate which is mezothermal and has little or no water shortage [16 and 17].

At the first stage of the study area, 28 variables thought to have effects on production yield of fibre-chip wood in the production units of oriental beech forests which are continuous forest process units and can be measured for each unit. When developing these variables, natural structures of production units, their physical location, forest formation structures and their relations tried to be measured. At the second stage, the number of variables reduced logically to 22 and they were divided into 2 categories as general situation of the stand and natural structure of production unit. Group, name, code, unit, mean, standard deviation, and scale of 22 variables are presented in Table 1.

Table 1. Groups, Names of Variable, Labels, Units, Some Statistics of the Variables
(Tablo 1. Değişkenlere Ait Grup, İsim, Etiket, Birim ve Bazı İstatistiksel Veriler)

Group	No	Name of variable	Label	Unit	Mean	Sdt. Dev.	Scale
General conditions of stand	1	Eta per ha (Allowable cut)	ALWBH	m^3 ha^{-1}	13.2	6.3	4.2-32.5
	2	Growing stock per ha	GSTCK	m^3 ha^{-1}	203.2	60.6	131-367
	3	Annual volume increment	VOLINC	m^3 ha^{-1}	3.8	1.4	0.4-6.6
	4	Stand height	HEIGHT	m	30.3	2.7	27-35
	5	Stand site quality degree	SSQUD	-	2.2	0.7	1-3
	6	Actual number of trees	NTREE	n ha^{-1}	344.2	148.9	139-689
	7	Actual basal area	BASAR	m^2 ha^{-1}	18.8	8.2	1.6-35.3
	8	Weighed Diameter class	DIAMTR	-	3.4	1.4	2-5
	9	Density of rhododendron	RHODO	-	2.9	0.7	2-4
	10	Density of other living cover	OTCVR	-	1.8	0.8	1-4
	11	Litter cover	LITTR	-	2.6	0.9	1-4
	12	Stand trunk quality	QUALT	-	2.6	1.0	1-4
	13	State of abiotic harm in the stand	ABIOT	-	2.1	1.2	1-5
Natural Structure	14	Elevation	ELEV	m	491.7	114.4	290-750
	15	Slope	SLOP	%	52.9	8.2	37-70
	16	Aspect	ASPECT	-	5.1	2.6	1-8
	17	Soil Depth	SDEP	-	1.9	0.3	1-2
	18	Erosion Level	EROS	-	2.4	0.5	1-3
	19	Stoniness	STON	-	1.9	0.3	1-2
	20	Average ground skidding distance	AVSKID	m	298.4	82.0	110-550
	21	Skidding direction	SKIDIR	-	1.1	0.3	1-2
	22	Transportation distance	TRNDIS	km	11.8	2.2	7.4-16.0

Evaluation of data; factor analysis was used to evaluate all variables simultaneously and, thus, to determine the most important factors affecting the rate of production yield in the units [18 and 19]. Data matrix with N x n (22x41) dimensions is the first input for factor analysis. Principal component model was used in the analysis as the extraction method by considering Varimax criterion with Kaiser Normalization as the rotation method [20].

After that production units were divided into groups considering the percentages of fibre-chip wood production and the sensitiveness of this new grouping was tested using discriminate analysis [19 and 21]. ArcMap 10, MS Office and SPSS 18.0 software packages were used for data obtaining, processing and analysing, respectively.

4. FINDINGS AND DISCUSSION (BULGULAR VE TARTIŞMA)

Fibre chip wood production rate in the units; fibre-chip wood production yield of production units varies from 0 to 36% depending on allowable cut (Figure 2). It was found from the results that fibre-chip wood production yield rate was the largest in unit 28 and 39 with the rate of 36% while the lowest was in unit 19 where no production of fibre-chip wood was recorded. Mean fibre-chip wood yield of 41 production units was found to be 15.93%.

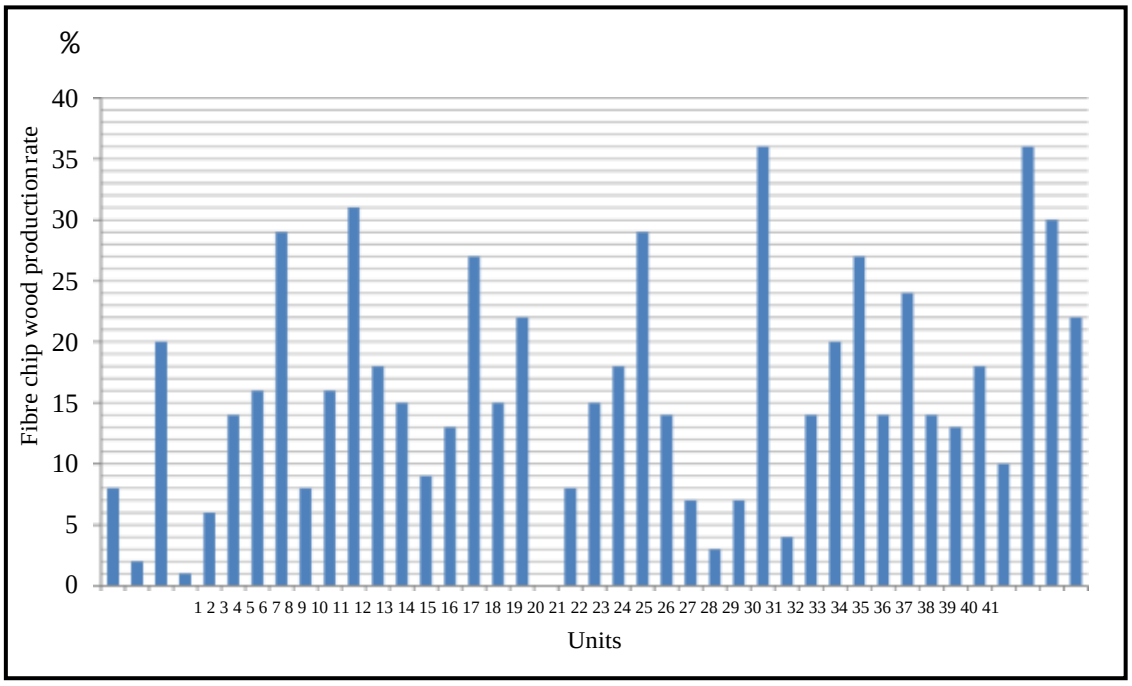

Figure 2. Fibre Chip Wood Production Rate in The Units
(Şekil 2. Bölmelere Ait Lif Yonga Odunu Üretim Oranları)

Most important factors to affect fibre chip wood production yield of units; at the first stage of data evaluation, variables in the data set were divided into groups in order to determine the most important factors to affect the fibre chip wood yield rate of production units using principal component analysis. First 7 components or factors among 22 components were extracted whose variance was larger than 1 (Kaiser Criterion) in the principal component analysis. Thus, 22 variables were reduced to 7 factors with a 19.6% data loss. According to the results of the principal component analysis with rotation, 80% of total variance among the 22 variables was explained by these 7 factors (Table 2).

In the principal component analysis, component matrix was rotated by the Varimax rotation method in order to get a more reliable and easier matrix of scientific explanations. Factors were named and interpreted according to the rotated component matrix. Factors with the dominant factor loading value above 0.5 as an absolute value are shown in Table 3 assuming that this is the threshold value in order to see the variable groups more clearly [18 and 19].

Table 2. Total Variance Explained (Tablo 2. Toplam Varyansın Dağılımı)

Factors (Components)	Initial Eigenvalues			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative (%)	Total	% of Variance	Cumulative (%)
1	5.93	26.93	26.93	3.39	15.43	15.43
2	3.46	15.74	42.67	3.28	14.91	30.34
3	2.77	12.60	55.27	2.66	12.08	42.42
4	1.68	7.62	62.89	2.52	11.47	53.89
5	1.43	6.51	69.40	2.23	10.14	64.04
6	1.31	5.97	72.37	1.87	8.52	72.56
7	1.11	5.02	80.39	1.72	7.84	80.39
8	0.74	3.35	83.74			
9	0.62	2.81	86.54			
10	0.56	2.54	89.08			
11	0.52	2.34	91.43			
12	0.40	1.80	93.23			
13	0.35	1.60	94.83			
14	0.28	1.27	96.09			
15	0.21	0.96	97.05			
16	0.18	0.84	97.89			
17	0.15	0.70	98.59			
18	0.11	0.49	99.08			
19	0.08	0.36	99.45			
20	0.06	0.28	99.72			
21	0.05	0.22	99.94			
22	0.01	0.06	100.00			

The bold number represents total variance explained by 7 factors.

Table 3. Rotated Component Matrix
(Tablo 3. Dönüştürülmüş Öğe Matriksi)

Variables	Factors (components)						
	1	2	3	4	5	6	7
SSQUD	0.901	-0.118	-0.055	-0.022	0.107	-0.234	-0.166
HEIGHT	-0.878	0.133	0.031	0.046	-0.150	0.269	0.156
STON	0.800	-0.242	-0.045	0.095	0.135	0.211	0.115
QUALT	-0.623	0.221	-0.371	-0.130	-0.022	-0.383	-0.008
ASPECT	-0.276	0.845	-0.058	-0.251	-0.011	-0.052	0.109
OTCVR	0.118	-0.836	0.089	0.140	0.218	-0.097	-0.056
LITTR	-0.341	0.793	0.085	-0.085	-0.085	-0.054	0.253
RHODO	0.050	0.786	-0.099	-0.243	0.030	0.012	0.007
SLOP	0.031	-0.069	0.869	-0.035	0.163	0.190	0.013
EROS	-0.137	-0.022	0.814	-0.010	0.017	0.313	-0.116
SDEP	-0.152	0.074	-0.700	-0.026	-0.361	0.195	-0.024
VOLINC	0.117	-0.174	-0.011	0.873	0.249	-0.021	-0.024
NTREE	-0.045	-0.341	-0.159	0.766	0.113	0.072	-0.200
DIAMTR	0.106	0.329	-0.147	-0.729	0.397	0.186	0.049
BASAR	0.084	-0.231	0.114	-0.047	0.843	-0.053	-0.086
GSTCK	0.224	0.068	0.287	0.248	0.793	0.187	0.010
ALWBH	0.203	-0.150	0.422	0.463	0.533	0.057	-0.051
ELEV	-0.148	-0.176	0.134	-0.025	0.057	0.872	0.016
ABIYOT	0.496	0.260	0.269	-0.011	0.145	0.610	-0.006
AVSKID	0.268	-0.226	-0.096	-0.054	0.181	-0.012	0.882
SKIDIR	0.073	0.078	-0.154	-0.278	0.078	0.036	-0.813
TRNDIS	-0.248	0.087	0.366	-0.324	-0.209	0.391	0.155

Bold numbers represent dominating factors (larger than 0.5 in absolute value).

TRNDIS, one of 22 variables in the set, did not take place under any factor as a factor having dominant factor load.

According to Table 2 the first component is the most important factor which shows 15.43% of total variance. Factor 1 is composed of SSQUD, HEIGHT, STON and QUALT with the production yield of unit. Among the factors, it is bonitet (stand site quality degree) that has the largest factor loading (0.901). Stand site quality degree is the value that reveals directly the production yield of production unit. An increase in the number representing the increase in stoniness rate and the stand site quality degree (i.e. reduction of stand site quality degree value) have negative effects on stand height and stand trunk quality. Factor 1 is so-called yield rate and SSQUD variable is accepted to be the representative of this factor.

Factor 2 is composed of ASPECT, OTCVR, LITTR and RHODO variables. General aspect of production unit is effective on the density of rhododendron, density of other living cover and litter cover. Due to the increased microorganism activities in south-looking aspects litter cover decomposes faster. Therefore, litter cover in the stand is generally thinner. As the aspect of production unit turns form south to north, density of rhododendron and density of other living cover increase depending on humidity content. Living cover in the area, especially the density of rhododendron, can cause industrial wood raw material to fracture, hit, strip and cleave when they are skidded to loading ramp. This situation may result in economical even production losses. Accepting ASPECT, which is effective on litter and living cover density, to be indicator variable, Factor 2 is so-called land aspect.

Factor 3 was composed of SLOP, EROS and SDEP variables. Sloppiness has determinant effect on skidding tool. In less sloppy units, roads for tractors can be constructed. Animal force is used in the area where it is impossible to use motor vehicles for skidding. However, when it is impossible to use both animal and motor force, hand rolling method is used to carry trunks out of the forest. This method naturally causes reductions in fibre – chip wood production yield. From this point of view, Factor 3 was named slope and represented by SLOP.

Factor 4 composed of the variables of VOLINC, NTREE and DIAMTR which are correlated with each other, represents yearly increase in growing stock per hectare of production unit, the number of trees and weighed diameter category. As the weighted average diameter category of stand increases, in other words, as the ratio of trees with larger diameters in stand, the number of trees decreases per hectare, however, yearly growing stock of stand increases. Yearly average growing stock increase of production unit and increase in mean diameter of stand may also increase fibre chip wood production yield in production unit. In such managements, branches of trees are suitable for fibre chip wood materials thus contributing to increase of yield rate in production unit. Factor 4 is so-called stand foundation structure and indicator was accepted to be VOLINC variable.

Factor 5 composed of the variables of BASAR, GSTCK and ALWBH among which there is a positive correlation, is the growing stock the production unit actually has and the volume of wood materials to be removed from per unit area (ha). Type of management in the estimation of eta planned to be removed from forest is an important parameter in determining growing stock. In spite of high stock increment, there may be conditions on which stand is not in optimal construction structure because of stock deficiency. In this case, planning should include stock increment at first. On the other hand, due to the high growing

stock increment rate decreases. This may cause different eta estimation since the stand is away from its optimal construction structure. In such forests, production yield may increase depending on the use of branches as industrial wood material. Therefore, Factor 5 is so-called growing stock represented by BASAR variable.

Factor 6 involving positively correlated ELEV and ABİYOT variables, shows abiotic harms in stand. Increasing elevation in production units may cause wind harms and increased rate of cracked trees. Collapsed trees have priority to be removed from the area before chopping predetermined trees. Such collapsed trees may be fully or partially rotten and therefore they cause industrial losses. Broken trees may be seen among the trees planned to be chopped and this again causes wood material losses. For this reason, Factor 6 is so-called abiotic harms represented by ELEV variable.

Variables of AVSKID and SKIDIR were included in the structure of Factor 7. Both of variables mentioned are associated with the removal of wood raw materials cut and standardized from production units in other words skidding methods. Skidding distance and direction determine the price of skidding together with mean sloppiness rate. In especially the areas where skidding direction is form bottom to top, prices may increase three folds. As the skidding distance increases the possibility of harms to wood materials can increase. From the field observations, it was seen that in the production units where production cost is high people work more properly and took cautions for industrial materials not to lose their properties. Therefore, from the characteristics of variable with the highest factor loading AVSKID, Factor 7 is so-called skidding distance.

Most important factors to affect fibre chip wood production yield and variables representing them are given in Table 4. 80.39% of fibre chip wood production yield is dependent on these factors.

Table 4. Factors Affecting Fibre-Chip Wood Production Rate in The Units
(Tablo 4. Bölmelerde Lif-Yonga Odun Üretimi Verim Yüzdesini Etkileyen Faktörler)

Factor No	Name of Factor	Weight of Factor (%)	Indicator variable of factor	Weight of Variable
1	Stand site quality degree	15.43	SSQUD	0.901
2	Aspect	14.91	ASPECT	0.845
3	Slope	12.08	SLOP	0.869
4	Annual volume increment	11.47	VOLINC	0.873
5	Actual basal area	10.14	BASAR	0.843
6	Elevation	8.52	ELEV	0.872
7	Average ground skidding distance	7.84	AVSKID	0.882
Total		80.39		

Categorisation of production units for their industrial wood production yield; production units were divided into 3 groups according to fibre chip wood production rates before analysis as shown in Table 5. Afterwards, sensitivity of these groups were tested using 22 variables and discriminate analysis.

Table 5. Groups of Production Units According to Yield Rate Before Discriminant Analysis
(Tablo 5. Diskriminant Analizi Öncesi Verim Yüzdesi Değerlerine Göre Bölme Grupları)

Group of units	No of units	Rate of fibre chip wood yield (%)	Group of units	No of units	Rate of fibre chip wood yield (%)	Group of units	No of units	Rate of fibre chip wood yield (%)
Group 1	28	36	Group 2	3	20	Group 3	38	10
	39	36		31	20		14	9
	11	31		12	18		1	8
	40	30		22	18		9	8
	8	29		37	18		20	8
	23	29		7	16		25	7
	16	27		10	16		27	7
	32	27		13	15		5	6
	34	24		17	15		29	4
	18	22		21	15		26	3
	41	22		6	14		2	2
				24	14		4	1
				30	14		19	0
				33	14			
				35	14			
				15	13			
				36	13			
High yield rate: ≥21%			Moderate yield rate: 11-20%			Low yield rate: ≤10		

Shaded numbers represent production units whose groups changed after discriminate analysis.

Two discriminate functions were obtained from the analysis which can be used to group production units according to the rates of fibre-chip wood production. Table 6 gives standardized canonical coefficients related to these functions and some parameters.

Table 6. Standardized Canonical Coefficients and Some Parameters of Discriminate Functions
(Tablo 6. Standardize Edilmiş Kanonikal Katsayı ve Diskriminant Fonksiyonları)

Variable	Function 1	Function 2	Variable	Function 1	Function 2
ALWBH	-0.020	1.165	SLOP	-0.362	-0.932
GSTCK	-0.660	0.419	ASPECT	0.263	-1.363
VOLINC	0.831	-1.142	SDEP	0.046	0.199
HEIGHT	0.227	2.007	EROS	-0.116	0.649
SSQUD	-0.665	2.501	STON	0.638	-0.829
NTREE	-0.106	1.265	AVSKID	0.697	0.250
BASAR	0.851	-0.404	SKIDIR	0.167	0.844
DIAMTR	0.236	1.005	TRNDIS	-5.876	1.403
RHODO	0.655	-0.187	Eigenvalue	1.916	0.991
OTCVR	0.898	0.082	% of variance	65.9	34.1
LITTR	1.217	1.746	C. correlation	0.811	0.705
QUALT	-0.836	-0.551	Wilks' lambda	0.172	0.502
ABIOT	-0.174	-1.391	Chi-square	48.364	18.931
ELEV	0.125	0.603	Sig.	0.301	0.590

Table 7 presents the results of the classification of production units in discriminate analysis according to 22 variables; Table 8, Figure 3 and 4 give the groups of new production units after analysis.

When 22 variables were taken in the classification instead of yield rate, two production units in the first group (11 and 16) were changed to the 2nd group; one unit (8) was changed to 3rd group; one unit in the 2nd (15) was changed to 3rd group and another unit in the same group (35) was changed to the 1st group; 3 units in 3rd group (4, 19 and 38) were changed to the 2nd group. From the results, classification success was found to be 80.5% in the categorization of fibre chip wood material production yield based on 22 variables.

Table 7. Classification Results
(Tablo 7. Sınıflandırma Sonuçları)

GROUP		Predicted Group Membership			Total
		1	2	3	
Original Count	1	8	2	1	11
	2	1	15	1	17
	3	0	3	10	13
Percentage	1	72.7	18.2	9.1	100
	2	5.9	88.2	5.9	100
	3	0.0	23.1	76.9	100

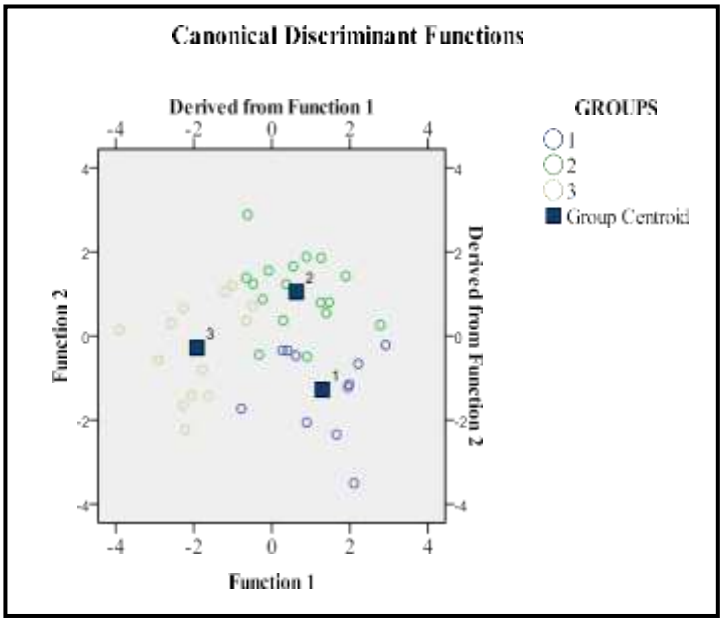

Figure 3. Distribution of Production Units for Discriminate Functions 1 and 2
(Şekil 3. Bölmelerin Discriminant Fonksiyonu 1 ve 2'ye Göre Dağılımları)

Table 8. Production Units According to Yield Rates After Discriminate
(Tablo 8. Diskriminant Analizi Sonrası Verim Yüzdelerine Göre Bölme Grupları)

Groups of production units	Number of production units	Name of production units
High yield rate	9	28, 39, 40, 23, 32, 34, 18, 41, 35
Moderate yield rate	20	3, 31, 12, 22, 37, 7, 10, 13, 17, 21, 6, 24, 30, 33, 36, 11, 16, 4, 19, 38
Low yield rate	12	14, 1, 9, 20, 25, 27, 5, 29, 26, 2, 8, 15

Shaded numbers represent production units whose groups changed after discriminate analysis.

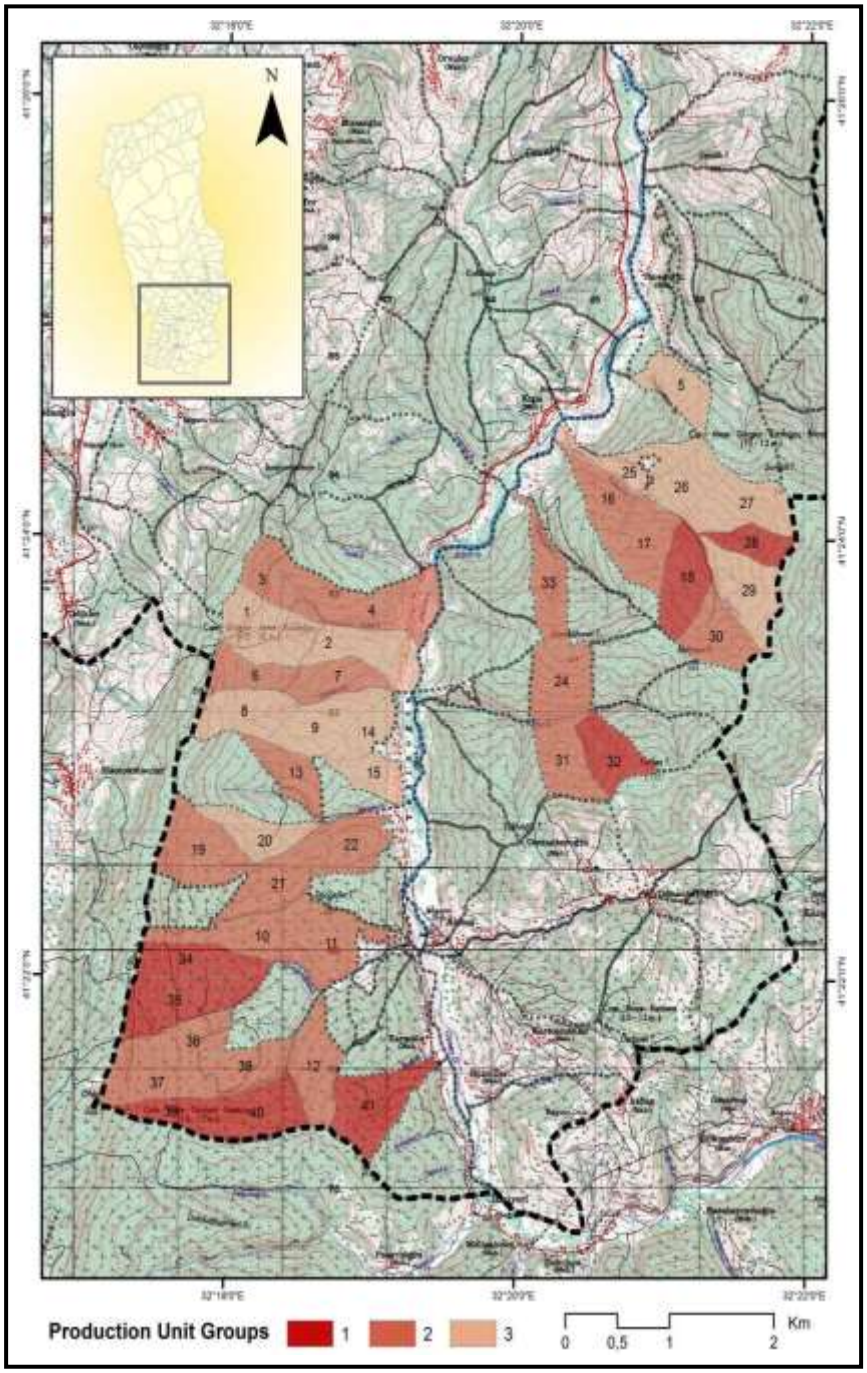

Figure 4. Location of Production Units on The Map For Their Yield Rates
(Şekil 4. Bölmelerin Verim Yüzdelerine Göre Harita Üzerindeki Konumları)

5. RESULTS AND RECOMMENDATIONS (SONUÇ VE ÖNERİLER)

Forestry activities are strictly different from other activities in their extended surface areas, long production time and obligatory sustainability. All the management plans in this type of management should be made considering expected goods, services and functions from the management (forest) in addition to its actual conditions. Even though the sector began to gain importance for the service and the function it provides globally, the degree of this importance increases consistently due to the products it can supply; especially wood raw materials and various types of products beyond wood.

Product outputs based on forest are not ultimate products but raw materials for other sectors. From this aspect, forestry is an important natural reserve all over the world for both wood raw material and employment it provides.

As in all management types seen in different sectors, it is a preferable situation in forestry to shape production rate according to market demand. This has become a vitally important situation since forestry supplies raw materials to several sectors. However, planned volume of wood material to be removed from forest areas may change depending on various factors. This is a situation which may deteriorate demand and supply balance of wood material. This imbalance can naturally affect other sectors.

Amount and type of industrial wood raw material among production units may vary depending on the differences in geographic characteristics and stand structures. Today increasingly growing fibre-chip plaque production sector is the largest receptor of fibre-chip wood raw material all over the world. Even though some part of products produced by forest managements are ultimate products for some sectors, for other sectors these products are raw materials. Therefore, estimation of the amount of fibre-chip wood material is especially important for the related sectors.

In the study, the effects of variables were determined which are thought to be effective on fibre-chip wood amount obtained from production unit and resulting from natural structure of production unit and forest location.

The study was conducted using data from 41 production units in Bartın-Günye state forest management. All of the units are pure oriental beech forests (Fagus orientalis Lipsky.) and continuous forest process units. Factors affecting yield were objectively evaluated adopting a multidimensional approach. According to the results, fibre-chip wood production yield was dependent in the rate of 80.4% on 7 factors; (1) stand site quality degree (2) aspect (3) sloppiness (4) actual basal area (5) annual volume increment (6) abiotic factors (7) average ground skidding distance. In addition, production units were divided into 3 categories according to fibre-chip wood yield percentage using discriminate analysis (high, moderate, low).Production units in the study have high, moderate and low yield percentage in the rates of 21.9, 48.8 and 29.3% respectively. In order to obtain a well-balanced production supply in the management, these yield groups should be taken into consideration when including yearly production units. In addition, findings may shed light on the calculation of selling prices and yield estimation of growing stock.

Present study dealt with the factors affecting wood production in industrial wood production units using multidimensional statistical analyses and different methodological approaches. Variables evaluated were partly obtained from management plans, united price calculation notebooks and using GIS through digitizing forest map. Findings in the present study should be accepted to be variable depending on time and locations. However, they may help private firms make a balance determine yield percentage and when they supply industrial wood material to market and have different geographical structures, different plant species, forest structure, management methods, production tolls and methods.

REFERENCES (KAYNAKLAR)

1. Lyke, J. and Brooks, D.J., (1995). World supply and demand for forest products. Journal of Forestry; 93(10), ss:22-26.

2. Brooks, D.J., (1997). Demand for wood and forest products: Macroeconomic and management issues. XI. World Forestry Congress, Antalya; 4, ss:66-75.
3. Pearce, P.H., (1990). Introduction of forestry economics. University of British Colombia Press; Vancouver, 398 s.
4. Anon., (2001). Report of forestry special expertise commission in the preparation of 8th five – year development plan. 539 s.
5. Örs, Y. and Keskin, H., (2000). Wood material knowledge. Gazi University. 2000:352. 183s.
6. Food and Agriculture Organization of the United Nations, (2011). http://faostat.fao.org (access date: 14.01.2013).
7. Anon., (2007). Report of forestry special expertise commission in the preparation of ninth five – year development plan. 102 p.
8. General Directorate of Forestry, (2012a). Strategic plan. General Directorate of Forestry Press; Ankara, 82s.
9. General Directorate of Forestry, (2013). Republic of Turkey Ministry of Forestry and Water Affairs General Directorate of Forestry. Forestry of Turkish, Ankara. http://www.ogm. gov.tr. (access date: 14.01.2013).
10. Kalaycıoğlu, H., (2001). Neden OSB. Laminart Mobilya, Dekorasyon, Sanat ve Tasarım; 12, ss:136-138.
11. Dayanıklıoğlu, S., (2004). Türkiye'de lif levha ve yonga levha sektörünün durumu, Avrupa birliği ülkeleriyle karşılaştırılması, problemleri ve çözüm yolları. İstanbul Üniversitesi Fen Bilimleri Enstitüsü, Yüksek Lisan Tezi; 146 s.
12. Acar, H. and Ünver, S., (2004). Determination of the harmful effects of wooden raw materials regarding technical and environmental aspects and recommendations for the solution. Journal of the Bartın Faculty of Forestry; 6(6), ss:165-173.
13. General Directorate of Forestry, (2001). Günye Management Plan (2001-2010); 400 s.
14. General Directorate of Forestry, (2011). Günye Management Plan (2011-2020); 359 s.
15. MGM, (2013). Meteoroloji Genel Müdürlüğü verileri.
16. Atik, A., (2013a). Effect of different concentrations of effective microorganisms (Baikal EM1) on the root collar diameter and height growth in the seedlings of Anatolian black pine [Pinus nigra Arnold. subsp. pallasiana Lamb. (Holmboe)]. International Journal of Food, Agriculture & Environment; 11(2), ss:1300-1304.
17. Atik, A., (2013b). Effects of planting density and treatment with vermicompost on the morphological characteristics of oriental beech (Fagus orientalis Lipsky.). Compost Science & Utilization; 21(2), ss:87-98. doi:10.1080/1065657X.2013.836066.
18. Harman, H.H., (1967). Modern factor analysis. 2nd ed. University of Chicago Press, Chicago, Illinois, 474 s.
19. Yılmaz, B., Daşdemir, İ., Atmış, E., and Lise, W., (2010). Factors affecting rural development in Turkey: Bartın case study. Forest Policy and Economics; 12(4), ss: 239-249. doi:10. 1016/j.forpol.2010.02.003.
20. Hair, J.F., Anderson R.E., Tatham R.L., and Black, W.C., (1992). Multivariate data analysis with readings, 3rd edn. Macmillan, New York.
21. Atik, A., (2013c). Zonguldak-Gökçebey Orman Fidanlığında üretilen 2+0 yaşlı doğu kayını (Fagus orientalis Lipsky.) fidanlarının kalite sınıflarının oluşturulması ve TSE Normlarına göre değerlendirilmesi. NWSA-Ecological Life Sciences, 8(2),1-12. doi.URL:10.12739/NWSA.2013.8.2.5A0073.