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Editorial Office
Croatian Forest Research Institute
Cvjetno naselje 41,
10450 Jastrebarsko
Tel: 385 (0)1 62 73 000
Fax: 385 (0)1 62 73 035
E-mail: seefor@sumins.hr; dijanav@sumins.hr; ivanb@sumins.hr
www.seefor.hr

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Hobitton
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hobitton@hobitton.com; www.hobitton.com

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Dear readers,

As usual, within this number of the SEEFOR Journal we bring you seven interesting papers written by authors from several countries of the South East European Region. Papers cover different areas of forestry, from genetics (***Lučić et al.***), forest management (***Popović et al., Redei et al.***), forestry economics (Keča and Keča), forest policy (***Marić et al., Lovrić et al.***) and environmental protection (***Benko et al.***).

We use this opportunity to inform you about International IUFRO Conference ***"Forests for cities, forest for people – Perspectives on urban forest governance"*** which was held on 27 – 28th October 2012 in Zagreb and we hope successfully hosted and organized by Croatian Forest Research Institute. Selected papers from IUFRO Conference will be published within next issue of the SEEFOR Journal.

At the end of this year, we wish all readers of the SEEFOR Journal Merry Christmas and a Happy and Successful New Year 2013!

Dijana Vuletić
Editor-in-chief

SEEFOR SOUTH-EAST EUROPEAN FORESTRY

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Original scientific paper

Analysis of Genetic Variability of Austrian Pine (*Pinus nigra* Arnold) in Serbia Using Protein Markers

Aleksandar Lučić

Institute of Forestry,
Kneza Viseslava 3
11000 Belgrade
Serbia
aleksandar.lucic@gmail.com

Vasilije Isajev

Faculty of Forestry
Kneza Viseslava 1
11000 Belgrade
Serbia

Ljubinko Rakonjac

Institute of Forestry,
Kneza Viseslava 3
11000 Belgrade
Serbia

Vladan Popović

Institute of Forestry,
Kneza Viseslava 3
11000 Belgrade
Serbia

Radovan Nevenić

Institute of Forestry,
Kneza Viseslava 3
11000 Belgrade
Serbia

Tatjana Ćirković-Mitrović

Institute of Forestry,
Kneza Viseslava 3
11000 Belgrade
Serbia

Ljiljana Brašanac-Bosanac

Institute of Forestry,
Kneza Viseslava 3
11000 Belgrade
Serbia

Abstract

Background and purpose: The aim of present research is to study intra- and inter-population genetic variation in Austrian pine by the application of biochemical markers. A better knowledge of the genetic potential of Austrian pine populations will enhance the production of seed and planting material, and in this way also the success of afforestation and the establishment of Austrian pine specific-purpose plantations.

Material and methods: The polymorphism of protein markers was determined based on the selected genotypes originating from six populations (seed stands) in Serbia. Based on the derived electrophoregrams, qualitative and quantitative differences (number and pattern) in protein fractions were identified and the seed protein profile was constructed for each tree, as well as for each of the six study populations. Analysis of protein markers was performed using two statistical methods, NTSYS and correspondence analysis.

Results and conclusion: The conservativeness of some polypeptide, i.e. the presence in all analysed genotypes is showed. On the other hand, some protein fractions were variable at the population level, and some were variable depending on the population. The degree of genetic variation among the populations was higher than the variation within the populations. There was also a high genetic variation in seed proteins within the analysed populations. Both methods (NTSYS and correspondence analysis) give the same arrangement of the analyzed populations, whereby, because of a different view of genetic distances, they can and should be combined, enabling easier and more precise understanding of mutual relationships of the observation units.

Keywords: Austrian pine, proteins, polymorphism

INTRODUCTION

Pinus is considered as one of the most genetically variable plant genera, which is revealed by the assessment of its quantitative genetic variation [1], isozyme analysis [2-5] and RAPD markers [6-10].

For more than a century, Austrian pine has been in the focus of forestry scientific and professional public.

The interest in this species is primarily the result of its characteristics: high genetic potential and genetic variation, as well as the taxonomic complexity and plasticity of the species. Its protective and reclamation function on the most severe terrains is the consequence of its extraordinarily low site demands. Austrian pine thriving over large areas attacked by erosion, or on completely degraded and denuded areas, where it produces excellent results, classifies it among the most important economic species in forestry. All the above Austrian pine characteristics, along with its wide native range and disjuct distribution, led to Austrian pine intensive introduction to the sites outside its native range, which resulted in a great number of subspecies and transition forms. The result of this natural variation is a high genetic potential which provides the base and the potential for the successful breeding of the species.

Taking into account the advancement of the concepts of nursery production, i.e. the tendency of abandoning the planting material production at the level of the species [11, 12] and in the aim of the most efficient and fast realisation of the tasks, it is necessary to enhance the study of the genetic potential of Austrian pine populations, because its directed implementation can improve the production of seed and planting material, and in this way also the success of afforestation and establishment of specific-purpose plantations of this species.

Consistent with the above problem which is assigned to modern forestry, the objective of the present study is to research and identify genetic variability of Austrian pine in Serbia, as one of the most important commercial species, irreplaceable in afforestation.

MATERIAL AND METHOD

The Official List of seed stands in Serbia includes six Austrian pine seed stands, which are presented in Figure 1 and Table 1.

Thanks to the occasional abundant yield of Austrian pine seed stands in Serbia, in October and November 2005, it was possible to collect the seeds at all six sites and in this way to embrace all Austrian pine seed stands.

The proteins were isolated from seeds of 55 trees of six populations, according to Wang et a. [14], and separated by PAGE according to Leammli [15]. The qualitative and quantitative differences (number and pattern) in protein fractions were detected based on the electrophoregrams. Coefficients of similarity were calculated after Jaccard [16] and Sokal and Michener [17].

TABLE 1
Main data on seed stands [13]

	Population of Austrian pine
I	MU "Divan-Breze", 27a.; FE "Šumarstvo" Raška
II	MU "Divan-Lokva", 21a.; FE "Šumarstvo" Raška
III	MU "Crni vrh Ljeskovac", 69 c.; FE "Prijepolje" Prijepolje
IV	MU "Šargan", 22 b.; FE "Užice" Užice
V	MU "Goč-Gvozdac", 92b.; Faculty of Forestry-Beograd-Goč
VI	MU "Studenica-Polumir", 17c, 26a.; FE "Stolovi" Kraljevo

FIGURE 1
The studied populations of Austrian pine

Jaccard $GS_{ij} = a/a+b+c;$
Sokal i Michener $GS_{ij} = a+d/a+b+c+d$

Where:
a - band presence in both genotype *i* and *j* (1.1)
b - band presence in genotype *i* and absence in genotype *j* (1.0)
c - band presence in genotype *j* and absence in genotype and (0.1)
d - band absence in both genotype *i* and genotype *j* (0.0)

Cluster analyses were carried out on the matrix of genetic similarities using the unweighted pair-group method using arithmetic averages (UPGMA) clustering algorithm. The dendrograms were constructed using NTSYS-PC software [18]. Also, a graphic interpretation of obtained results was made using graphics of correspondence analysis in 3D.

RESULTS AND DISCUSSION

The polymorphism of protein markers intra and inter Austrian pine populations was identified based on the selected genotypes within each population. The analysis of the derived electrophoregrams shows clearly that the analysed samples had a specific protein pattern. In order to determine the genetic similarity among the study genotypes, NTSYS dendrogram and graphs of correspondence analysis was performed based on the analysis of protein markers within Austrian pine populations.

The similarity matrices after Jaccard and Sokal and Michener produced diagram I with the identical pattern of genotypes within population I, and genotypes within population II, i.e. VI, whereas the values of genetic similarity were in different ranges. The graphical analysis of genotypes in population II distinguishes tree groups (Diagram 1). One group consists of genotypes II-1, II-7 and II-8, and the other is formed of genotypes II-2, II-4, II-3, II-5 and II-6. It should be noted that the grouping within groups occurs at small genetic distances. The line which consists of genotypes II-9 and II-10 is loosely linked to the above groups. Based on protein image, genotypes II-2 and II-4, as well as II-9 and II-10, are genetically identical.

It is characteristic for the populations III, IV and V, that the similarity matrices after Jaccard and Sokal and Michener did not produce NTSYS dendrograms and graphics of correspondence analysis with the identical patterns of genotypes, and the values of genetic similarity were also in different ranges. The graphical analysis for population IV shows two groups and one loosely linked line, which consists

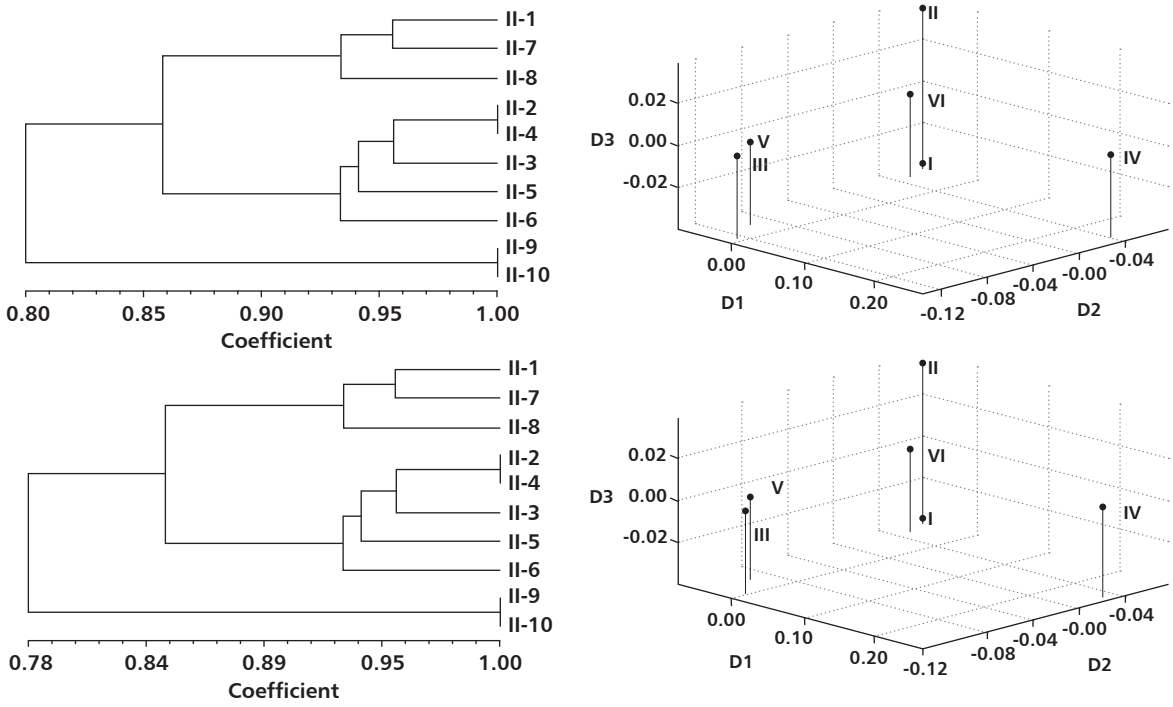

DIAGRAM 1
NTSYS dendrograms and graphics of correspondence analysis of population II genotypes after Sokal and Michener (a) and after Jaccard (b)

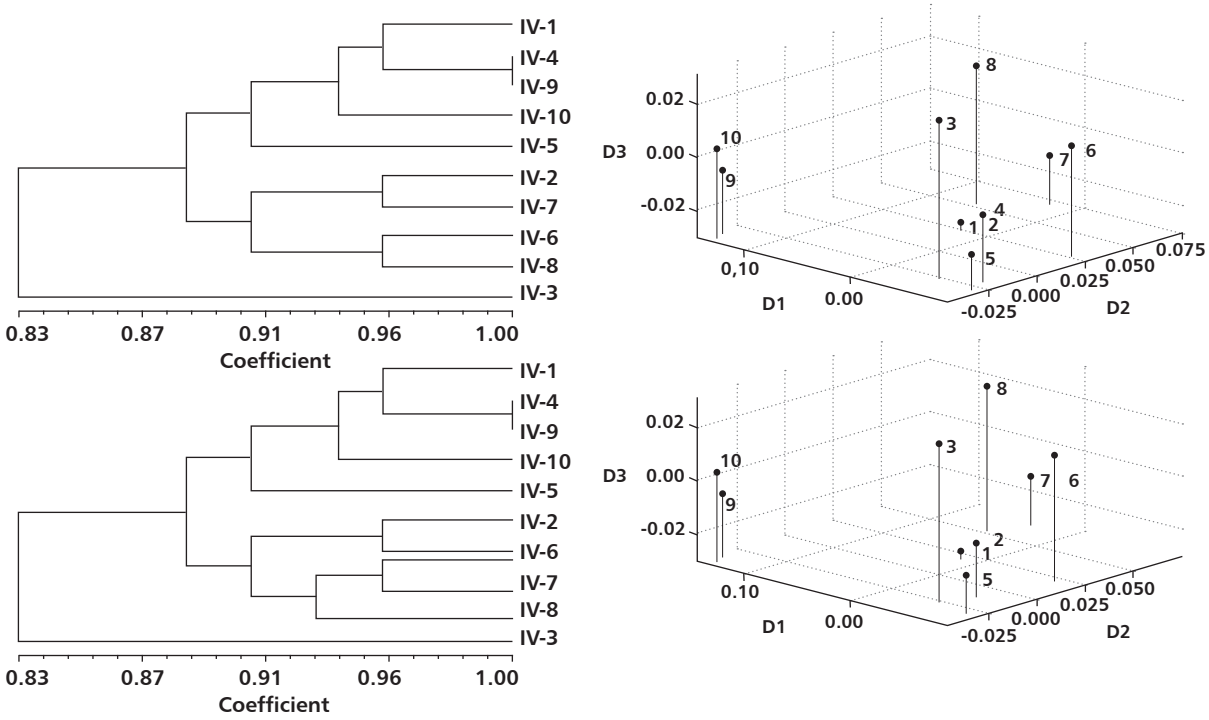

DIAGRAM 2
NTSYS dendrograms and graphics of correspondence analysis of population IV genotypes after Sokal and Michener (a) and after Jaccard (b)

of IV-3 genotype (Diagram 2). One group consists of genotypes IV-1, IV-4, IV-9, IV-10 and IV-5, while the other group consists of genotypes IV-2, IV-7, IV-6 and IV-8, which have different patterns depending on the applied method. Based on the analysis of protein markers, it is not possible to separate the genotypes IV-4 and IV-9. Population V is characterised by the fact that it has a significantly different pattern of genotypes, depending on the applied method. The common characteristic of both methods is the loose link of genotypes V-2 and V-6 to other genotypes (Diagram 3).

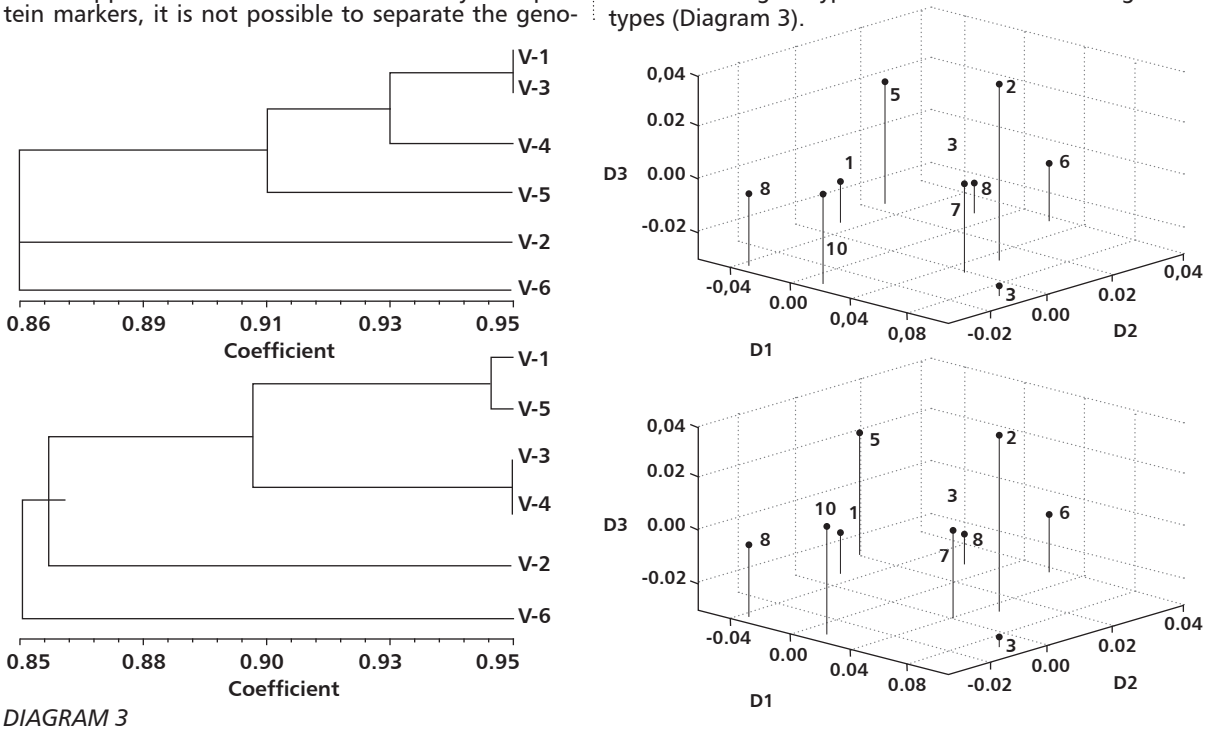

DIAGRAM 3
NTSYS dendrograms and graphics of correspondence analysis of population V after Sokal and Michener and after Jaccard

The values of intrapopulation diversity of protein markers were different among the six Austrian pine populations under study. The similarity coefficients of seed proteins of the above populations showed a high variation, which ranged from 0.64 to 0.95.

The analysis of polypeptide pattern, individual for each genotype, based on the cluster analysis dendrogram (Diagram 4) shows, with minor deviations, that the genotypes clustered in two groups, based on both similarity coefficients. The larger group consists of the genotypes in five populations (I, II, III, V and VI) and the other group consists of the genotypes in population IV. The genotype pattern in groups and subgroups differs depending on the applied coefficient. Based on Jaccard coefficients, the genotypes in population III are grouped together, making one subgroup, which also includes genotype V-5. The genotypes in population I, II and VI are grouped in smaller subgroups within group I, while the genotypes in population V are grouped without any rule. Based on Sokal and Michener coefficients, genotypes in population IV form a special group. Within the first group, there are several differences in genotype patterns in subgroups according to Jaccard's dendrogram. Thus, genotype I-8, according to Sokal and Michener, is grouped together with another three genotypes in population I, whereas according to Jaccard, this genotype is grouped together with genotype II-7. Three genotypes in population V are also grouped together with the genotypes in population III. Based on the above dendrograms, at the population level, the genotypes are grouped within individual populations. This confirms the minor differences in site conditions and the differences among genotypes, and emphasises the significance of the populations.

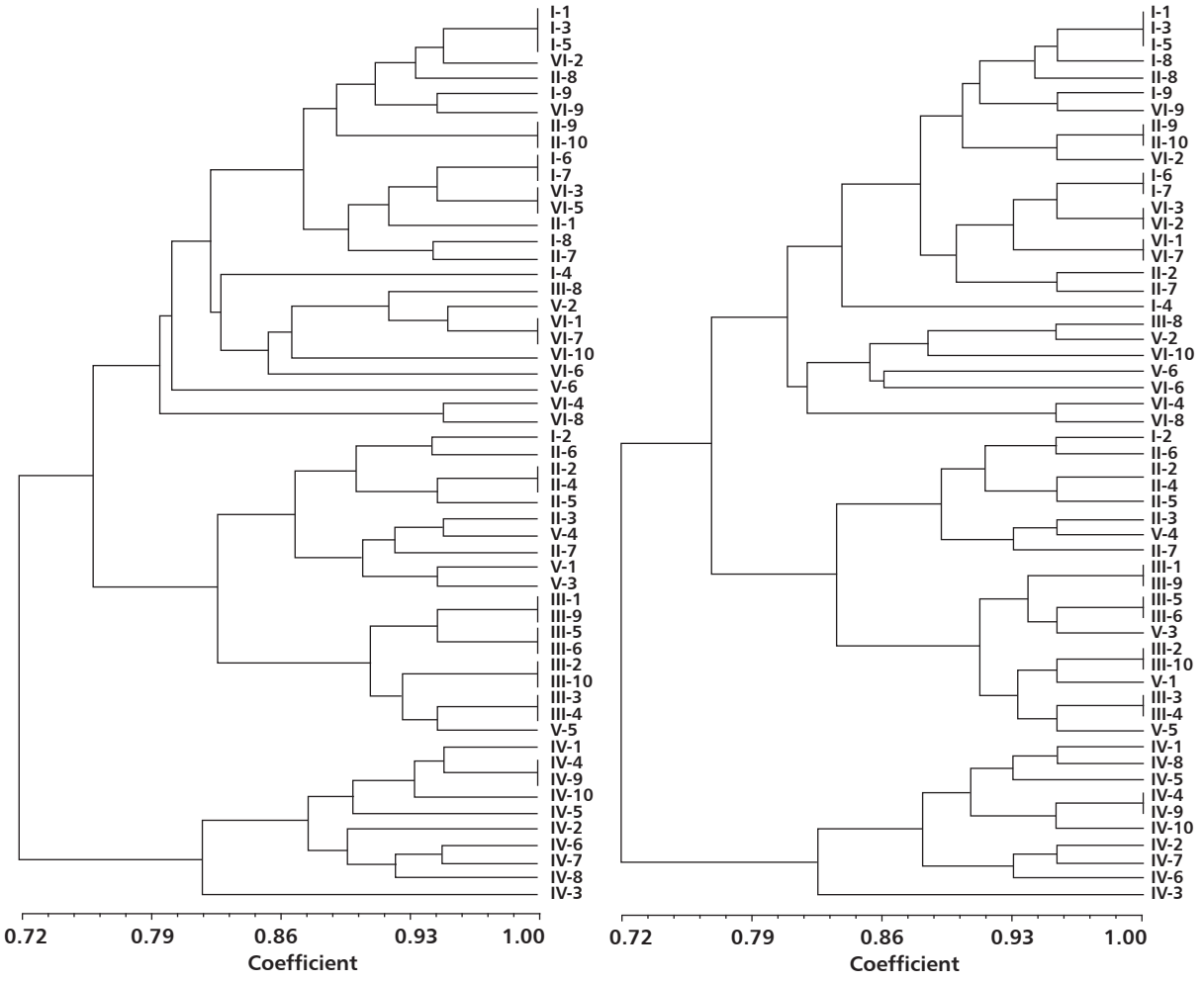

DIAGRAM 4
Dendrogram of genotypes of six Austrian pine populations after Sokal and Michener (a) and after Jaccard (b)

Graphics of correspondence analysis are not shown because the large number of genotypes led to inability to analyze the obtained results.

The results of the analysis of protein complex show that seed samples from different populations had different protein pattern. Two seeds were taken from each of 55 trees in six populations and grouped by localities, after which seed proteins were isolated from the formed sample and analysed by electrophoresis. The differences in number, pattern of protein fractions were determined. Total number of protein fractions was 22, of which 11 were polymorphic (50%). Seed protein profile was established based on the electrophoregram for each of the six study populations and the genetic similarity coefficients among the study populations were calculated.

To determine the genetic similarity among the study genotypes, NTSYS dendrograms and graphics of correspondence analysis was performed based on the analysis of protein markers among Austrian pine populations.

Similarity matrices after Jaccard and Sokal and Michener generated the dendrograms with the identical pattern of genotypes, while the values of genetic similarity were in different ranges. Same results were obtained using graphics of correspondence analysis. NTSYS dendrograms and graphics of correspondence analysis of the populations were characterised by a high genetic diversity among the study populations expressed by the graphical form. The comparative analysis of the generated NTSYS dendrograms and graphics of correspondence analysis shows clearly that, populations I and VI, as well as III and V, were at the smallest genetic distances. Population II was more loosely linked to populations I and VI than to III and V. An interesting characteristic of NTSYS dendrograms and graphics of correspondence analysis is the character of the link of population IV to other populations. Austrian pine on Mt. Šargan had an extremely loose link to other populations, which was the result of a great genetic distance compared to other populations. Similarity matrices according to Jaccard and Sokal and Michener were compared by Mantel test. A high degree of correlation was established between pairs of similarity matrices (r=0.997).

Seed proteins are relatively frequently applied as genetic markers in the study of forest tree genomes, but there are relatively few studies on Austrian pine [5, 19]. The polymorphism of Austrian pine seed proteins was researched aiming at the assessment of genetic variation intra- and inter- populations. There was a higher degree of genetic variation among populations than within populations. Also there was a high genetic variation of seed proteins within populations.

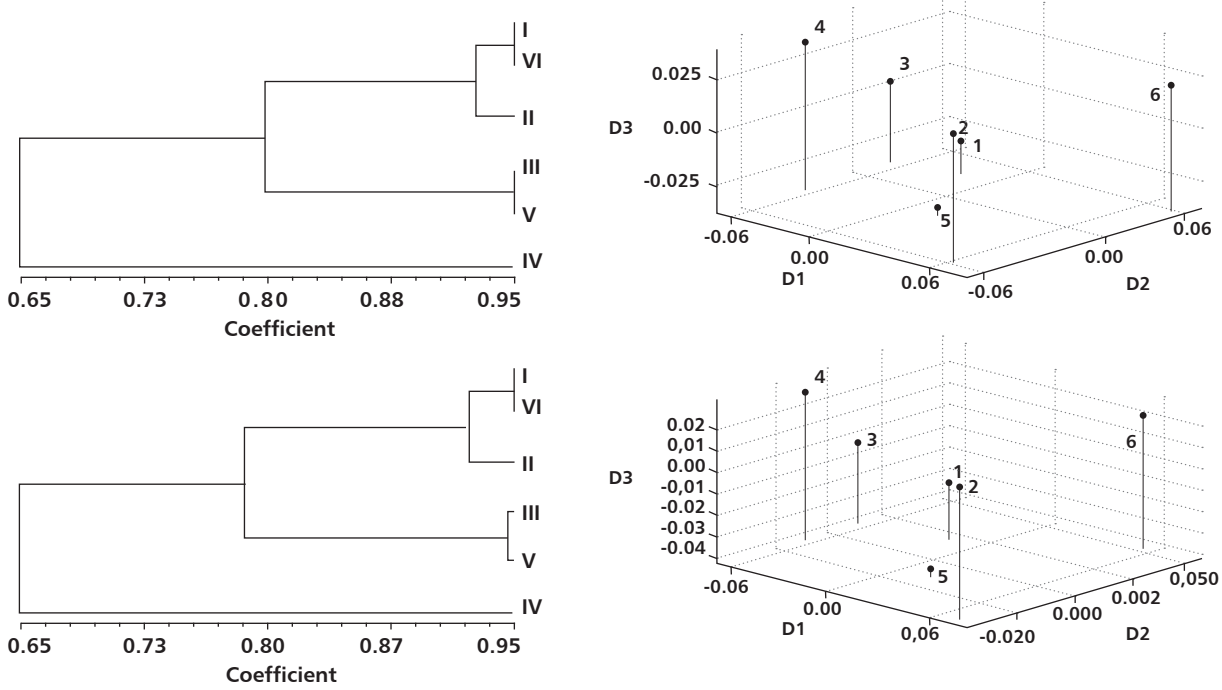

DIAGRAM 5
NTSYS dendrograms and graphics of correspondence analysis of populations after Sokal and Michener (a) and after Jaccard (b)

These results are compatible with the results reported by Forrest [20] and Mataruga [5], which point to the absence of site effects on the protein complex, as well as with the results which show the variation among the analysed populations which are spatially isolated, Bahrman [21]. In general, conifers are characterised by a very high level of genetic variation, Hamrick [2], and the potential factors are a) longevity, free pollination with high fertility, and b) divergent selection for macro-micro geographic adaptation. According to Scaltsoyiannes et al. [22], Pinus nigra is characterised by a high total variation because of the high intrapopulation genetic variation, which points to a high genetic variation in local populations and the possibility that the same alleles are distributed throughout the entire range of this species.

CONCLUSIONS

Based on the study results, it can be concluded that the analysis of seed proteins shows a specific protein pattern of all analysed genotypes. This showed the "conservativeness" of some polypeptides, i.e. the presence in all analysed genotypes. On the other hand, some protein fractions were variable at the population level, and some were variable depending on the population.

Based on the cluster analysis, the population IV, MU "Šargan" 22b, FE "Užice" – Užice was clearly separated from other populations, and populations III and V were grouped together at smaller distances. Population IV had the smallest genetic similarity among the analysed genotypes, showing the greatest distance from populations I, II and V, and a slightly greater genetic similarity with populations III and VI.

The values of intrapopulation diversity in the applied markers are much higher than it was recorded among the study of six Austrian pine seed stands. From the aspect of commercial forest seed production, the results are significant for future activities on defining Austrian pine population regions in Serbia, because they point to the fact that the genetic distances among the analysed seed stands are such that they can affect the future trade of seed material in the sense of its use in specific-purpose nursery production.

Both methods (NTSYS and correspondence analysis) give the same arrangement of the analyzed populations, whereby, because of a different view of genetic distances, they can and should be combined, enabling easier and more precise understanding of mutual relationships of the observation units.

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Original scientific paper

Variability of Diameter Increment of Taxodium (*Taxodium distichum* (L.) Rich.) Under the Influence of Climatic Factors in the Area of Bačka Palanka in Serbia

Vladan Popović
Institute of Forestry,
Kneza Viseslava 3
11000 Belgrade
Serbia
vladanpop79@gmail.com

Mirjana Šijačić-Nikolić
Faculty of Forestry
Kneza Viseslava 1
11000 Belgrade
Serbia

Tatjana Ćirković-Mitrović
Institute of Forestry
Kneza Viseslava 3
11000 Belgrade
Serbia

Dušan Jokanović
Faculty of Forestry,
Kneza Viseslava 1,
11000 Belgrade,
Serbia

Aleksandar Lučić
Institute of Forestry,
Kneza Viseslava 3
11000 Belgrade
Serbia

Ljubinko Rakonjac
Institute of Forestry,
Kneza Viseslava 3
11000 Belgrade
Serbia

Ljiljana Brašanac-Bosanac
Institute of Forestry,
Kneza Viseslava 3
11000 Belgrade
Serbia

Zoran Dražić
Borova Street 5/6
11000 Belgrade
Serbia

Abstract

Background and purpose: Knowledge of the interaction between plant and climatic conditions is of great importance in establishment of new forests, especially in the introduction. Taxodium is an allochthonous species in Europe and this paper presents the data on the success of its introduction and adaptability to site conditions.

Material and methods: For the analysis of the climate characteristics in Bačka Palanka have been used the data of the Republic Hydrometeorological Service of Serbia for the period 1981-2010 regarding meteorological station Rimski Šančevi. Dendrometric analysis was performed on the dominant trees of Taxodium by taking an increment core at breast height using Pressler drill. On the increment cores was measured diameter increment per each year of the observed period. By the regression analysis was determined the correlation between the diameter increment and climate elements.

Results and conclusion: By research of influence of climate factors on the diameter increment of Taxodium trees can be concluded that with increasing of values of mean annual temperature and mean temperature during the growing season comes to a reduction in size of the diameter increment. The increase of the quantity of precipitation over a year, particularly during the growing season, leads to the increase of the diameter increment, and vice versa.

Keywords: Taxodium, climate, diameter increment, Bačka Palanka.

INTRODUCTION

A number of studies on the global warming and potential changes of temperature and humidity, point to the very wide range of the effects and impacts, both on the forest ecosystems in general, and on the individual trees [1-3], the knowlegde on these interrelations and interactions plant-climate parameter, is of the growing importance. The afforestation and establishment of the conifer plantations in Serbia was very intensive during the last decades of the 20th century, and the conifer species were used not only for the afforestation of barren soil, but introduced in the forests of different tree species and degrees of degradation, on the sites of

the different production characteristics. The influence of some climatic factors on the diameter and height increment of some tree species studied Fritts [4-7], La Marche [8], Wimmer and Grabner [9], Kilgore and Telewski [10], Zafirov [11], Tokar and Krekulova [12] and in Serbia Koprivica and Matović [13], Vukin and Isajev [14], and Radošević and Vilotić [15] and others.

The main task of this paper is to analyze climate elements and Thornthwaite's climate index, current diameter increment of Taxodium trees from seed stands near Bačka Palanka, the analysis of the influences of the pluviometric regime and climate index on the current diameter increment of Taxodium over the period 1981-2010.

MATERIAL AND METHOD

Only by using the multi-annual climate data, obtained by the meteorological measurements, can the current climate condition be validly estimated. For the purposes of analyzing climate characteristics and change in Bačka Palanka, were used the data of Republic Hydrometeorological Service of Serbia for the period 1981-2010, regarding the meteorological station Rimski Šančevi (situated at latitude 45 ° 20 'N and longitude 19 ° 51' E) i.e. the arithmetic means of the series of the available data, sorted by time and area [16]. Seed stand of Taxodium is 70 years old, located in Forest management unit "Palanačke ade- Čipski poloj " section 11, department a, which manages the Forest Enterprise (FE) Novi Sad, Forest Administration Bačka Palanka.

The pluviometric regime and air temperature were analyzed and the climate index was determined for each year of the observed period by using Thornthwaite's method [17, 18]. By using the complex calculation method, which is now presented by the special computer program, based on the average monthly air temperature and the average monthly quantities of precipitation, taking into account the latitude at which the observed site is located and the duration of daylight, the calorific index (*i*) and the annual calorific index (*I*) are determined first, and then, by applying the special logarithmic nomograms the uncorrected potential evapotranspiration (*PE*) is calculated, while, by the subsequent calculation process, the actual evapotranspiration (*SE*) and the water loss in the soil (*M*).

The final results refer to the humidity index (I_h), aridity index (I_a), and climate index (I_c), based on which, by using the classification prescribed by this method, the character of the climate for the observed area is determined. The climate index calculated in this way is the result of the basic climate factors (temperature and precipitation regime), coupled with the basic orographic elements (geographic coordinates of the observed site and duration of daylight).

Mean stand diameter in this artificially established stand is 51.7 cm. Dendrometric analysis was done on the dominant trees of Taxodium whose mean diameter is 67.7 cm. From twenty trees that are in the category of 20% of the thickest were taken the increment cores at breast height using Pressler drill. On the increment cores was measured diameter increment per each year of the observed period that was 30 years (1981-2010).

By the comparative analysis and statistical data procession (regression analysis), the correlation between the diameter increment and climate characteristics was determined (Computer Software Statgraph 6.0). It is given the graphic presentation of the climate indices, quantity of precipitation during a year and in the growing season (April-September), the mean annual temperature, mean temperature during the growing season (April-September) and the diameter increment of Taxodium in the observed period.

RESULTS AND DISCUSSION

Research facility

The researches were conducted in artificially established Taxodium stand aged 70, which is located near Bačka Palanka. The stand is located in the Forest management unit "Palanačke ade- čipski poloj", in Departmant 11a, at the altitude ranging from 76 to 80 meters above the sea level, on flat ground, with no clear exposure, on fluvisol soil type. It belongs to the coeno-ecological group of forest types of white willow and poplar (Salicion albae) on undeveloped, semigley soil.

Climate elements

Heat and humidity, along with other environmental factors, directly influence height, diameter and volume tree increment and stands in general, as well as the quality of wood volume. If the environmental conditions are the same, the quantity of wood volume, which can be produced by the forest vegetation, and the technical value of it, depend upon the variation of some basic climate factors [19].

Air temperature over the period 1981-2010

Air temperature is one of the most important climate parameters. Based on the processed data obtained by the Republic Hydrometeorological Service of the Republic of Serbia, the data on air temperature in the observed period (from 1981 to 2010) for the Rimski Šančevi Weather Station are presented in Table 1.

The average annual air temperature over the observed period is 11.4 °C, whereas the average air temperature during the growing season is 18.3 °C. In the

hottest month of the year, July, the average air temperature is 21.9 °C, while in the coldest month of the year, January, it is 0.2 °C.

The average annual temperature in the observed period ranges from 10.1 °C (in 1981) to 13 °C (in 2000).

TABLE 1

The average monthly and annual air temperatures in Bačka Palanka area (°C), over the period 1981-2010

Year	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Aver.
1981	-3.1	1.3	9.1	11.0	16.2	20.3	20.4	20.4	17.5	12.9	4.8	1.7	11.0
1982	-1.6	-0.7	5.4	8.0	17.9	20.8	21.1	20.7	20.1	13.1	5.6	4.2	11.2
1983	3.9	0.8	7.9	14.0	18.1	19.1	22.7	21.3	16.6	10.7	2.5	0.9	11.5
1984	1.1	0.5	5.0	10.6	16.1	18.3	19.3	20.0	18.0	13.2	6.2	0.2	10.7
1985	-5.5	-4.8	4.8	11.9	18.2	17.2	21.5	21.1	16.8	10.1	4.4	5.5	10.1
1986	1.6	-3.0	4.3	13.8	18.6	19.1	19.7	22.0	17.1	11.1	5.3	-0.2	10.8
1987	-3.9	1.2	-0.2	11.2	14.7	20.2	23.5	19.3	20.1	12.2	7.1	2.1	10.6
1988	3.5	3.8	5.5	10.3	17.1	19.8	23.7	22.4	17.2	11.1	0.3	2.3	11.4
1989	-0.3	4.7	9.4	13.9	15.5	17.8	21.9	21.1	16.5	11.8	4.8	2.5	11.6
1990	0.6	5.8	9.4	11.1	17.5	19.9	21.4	21.6	15.1	12.4	6.9	1.3	11.9
1991	1.0	-2.6	8.1	9.6	12.8	19.9	21.8	20.1	17.7	10.2	6.6	-1.7	10.3
1992	1.0	3.2	6.7	12.6	17.2	20.1	22.0	25.9	17.3	11.6	7.1	0.5	12.1
1993	-0.2	-1.9	4.3	11.2	19.1	19.9	21.5	22.0	16.6	13.1	2.3	3.3	10.9
1994	2.7	2.1	8.9	11.7	17.0	20.1	23.5	23.0	20.3	10.0	6.6	2.1	12.3
1995	-0.1	6.5	5.7	11.2	15.8	19.0	23.3	20.3	15.4	12.0	3.2	1.7	11.2
1996	-1.1	-2.4	2.2	11.6	18.1	20.6	20.0	20.8	13.1	11.6	8.5	0.5	10.3
1997	-1.4	3.3	5.5	7.5	17.7	20.7	20.1	20.2	16.0	8.5	6.5	3.0	10.6
1998	3.2	5.2	4.0	13.2	16.1	21.5	21.6	21.7	15.7	12.7	4.2	-3.8	11.3
1999	0.8	1.7	8.0	12.7	16.9	20.1	21.2	21.3	18.9	11.6	4.1	1.1	11.5
2000	-1.8	3.9	6.8	14.7	18.5	22.0	22.2	24.3	17.2	13.9	10.4	3.3	13.0
2001	3.0	4.1	10.2	10.9	17.8	18.0	21.8	22.4	15.1	14.1	3.6	-3.4	11.5
2002	0.2	6.7	8.6	11.1	19.1	22.0	23.5	21.5	16.4	12.1	9.5	0.5	12.6
2003	-1.9	-4.5	5.6	11.3	20.6	24.2	22.4	24.3	16.6	9.8	7.7	2.1	11.5
2004	-1.2	2.4	6.4	12.0	15.0	19.5	22.1	21.4	15.9	13.5	6.5	2.6	11.3
2005	0.1	-3.7	4.3	11.8	17.2	19.4	21.4	19.5	17.3	11.6	5.3	2.1	10.5
2006	-1.3	0.9	5.7	12.7	16.5	19.7	23.6	19.7	18.0	13.3	7.6	2.8	11.6
2007	6.1	5.8	8.9	13.4	18.5	22.1	23.3	22.7	14.6	10.6	3.9	0.0	12.5
2008	1.9	4.8	7.9	13.0	18.4	21.9	21.7	22.2	15.7	13.2	7.9	3.7	12.7
2009	-1.5	2.2	6.8	14.6	18.6	19.6	22.8	23.0	19.3	11.7	8.3	3.5	12.4
2010	-0.6	1.9	6.8	12.3	17.0	20.2	23.1	21.9	16.1	9.1	9.5	0.8	11.5
Aver.	0.2	1.6	6.4	11.8	17.3	20.1	21.9	21.6	16.9	11.8	5.9	1.5	11.4

Precipitation regime over the period 1981-2010

The data on the pluviometric regime are presented in the Table 2. The annual quantity of precipitation in Bačka palanka area over the observed period is 647.3 mm of rainfall, and it ranges from 287,8 mm (in 2000) to 938,4 mm (in 1999). During the growing season (April-September), the average quantity of precipitation is 379.0 mm, which accounts for 58.6% of the total annual precipitation. The month with the greatest number of rainy days is June, with 91.4 mm of rainfall, and the month with the smallest number of rainy days is February, with 31.4 mm of rainfall.

Hydrological balance determined by using Thornthwaite's method

The climate (hydrological) index according to Thornthwaite's method [17, 18], is one of the most comprehensive climate summary of some forest area. It is one of the indirect calculation methods for determination of hydrological balance and climate type. This method is, above all, frequently applied during the studies in forestry science, since it gives the greatest number of data on plant life [20, 21], such as the quantity of spare water in the soil (*R*, in mm) during the season when there is an excess of it *V* (mm), and during the season when there is a lack of it *M* (mm). Thornthwaite introduced the term potential evapotranspira-

TABLE 2
Monthly and annual sums of precipitation in Bačka palanka area (mm), over the period 1981-2010

Year	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Aver.
1981	35.8	18.4	117.1	39.6	38.0	204.5	20.4	63.2	85.9	63.7	45.1	99.3	831.0
1982	26.3	16.3	66.8	67.7	22.7	69.7	59.0	58.9	9.5	48.6	25.8	62.7	534.0
1983	43.4	19.7	23.4	31.9	35.9	87.6	58.1	34.3	75.3	27.6	18.7	23.3	479.2
1984	66.5	35.3	13.1	38.5	107.7	47.4	98.1	42.4	30.4	56.2	49.4	16.7	601.7
1985	30.2	63.7	65.0	42.6	83.2	77.8	29.0	80.0	10.9	11.3	70.3	17.6	581.6
1986	52.0	47.5	37.5	56.9	50.8	50.4	77.1	40.0	4.3	42.0	6.7	16.1	481.3
1987	101.8	2.3	63.1	80.8	175.7	62.0	31.6	50.5	5.5	11.9	83.2	29.7	698.1
1988	36.2	42.7	94.2	56.8	25.9	64.6	20.1	17.1	55.3	12.1	20.0	25.2	470.2
1989	6.5	8.6	35.2	82.1	66.2	92.5	11.1	72.4	30.0	32.5	50.0	19.9	507.0
1990	6.3	35.4	33.3	34.2	17.9	69.8	28.4	14.7	52.0	52.8	38.8	67.1	450.7
1991	15.1	23.3	46.9	46.6	76.5	71.5	192.9	47.4	35.7	110.7	75.4	20.7	762.7
1992	7.0	22.2	3.3	30.9	39.0	106.1	21.6	0.2	32.1	142.6	84.9	43.9	533.8
1993	15.3	5.3	52.9	30.1	39.4	40.2	41.6	35.7	38.2	19.6	68.2	87.4	473.9
1994	41.4	33.6	31.8	53.5	71.1	101.4	31.8	44.7	42.6	58.5	25.4	33.5	569.3
1995	75.1	51.3	42.8	54.0	60.1	108.8	4.1	75.9	101.8	0.6	39.6	64.2	678.3
1996	46.3	34.5	29.8	25.2	90.0	79.1	83.9	112.8	119.2	33.1	94.5	65.9	814.3
1997	44.1	46.6	32.2	75.2	17.4	62.0	123.2	124.6	30.3	92.2	34.6	81.7	764.1
1998	67.5	0.9	22.6	39.8	64.1	103.7	123.8	82.3	76.9	79.0	66.5	27.9	755.0
1999	42.2	47.8	11.1	61.2	76.2	91.0	209.1	28.2	76.9	52.4	103.8	138.5	938.4
2000	15.7	8.1	31.7	24.6	40.4	31.5	29.7	6.4	15.5	6.9	23.4	53.9	287.8
2001	38.4	28.6	75.9	156.0	78.6	237.4	80.4	29.5	160.1	14.7	71.4	27.6	998.6
2002	7.5	28.4	10.1	30.4	84.7	27.5	35.0	53.8	47.5	91.7	23.7	41.6	481.9
2003	49.2	21.5	8.9	9.2	21.9	30.7	61.5	30.4	83.3	142.3	29.0	21.3	509.2
2004	53.4	43.3	17.8	118.6	87.9	97.4	65.1	39.3	50.1	86.1	142.9	33.8	835.7
2005	30.2	41.6	40.1	33.0	38.1	135.8	122.5	133.9	67.0	7.1	19.6	66.5	735.4
2006	30.5	43.5	72.5	66.0	70.1	104.3	30.9	124.9	23.8	17.6	17.1	39.8	641.0
2007	47.7	50.7	78.8	0.0	99.4	71.1	38.8	79.6	78.8	101.4	119.5	32.8	798.6
2008	25.4	7.6	42.8	21.9	46.2	115.9	41.6	14.0	93.6	18.4	57.5	43.1	528.0
2009	40.8	47.3	34.6	3.6	50.4	127.2	58.1	19.1	13.1	81.9	63.1	97.4	636.6
2010	76.0	65.7	38.7	63.7	113.7	171.8	99.0	168.5	67.7	66.6	46.5	64.0	1041.9
Aver.	39.1	31.4	42.5	49.2	63.0	91.4	64.3	57.5	53.8	52.7	53.8	48.8	647.3

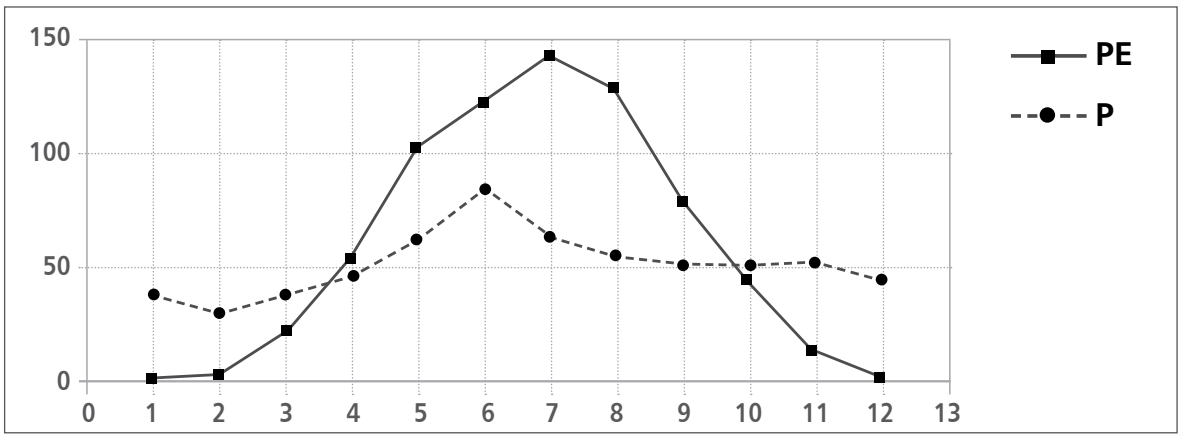
tion (*PE*). The uncorrected potential evapotranspiration (*PE*) refers to the quantity of water which would evaporate from the soil under the certain temperature conditions, when it reaches the optimal humidity, i.e. 100 mm of water up to 100 cm depth, throughout a whole year, i.e. 100 $l \cdot m^{-2}$. It is equal to 603 mm over the observed period 1981-2010. Since evapotranspiration depends not only on the energy-temperature characteristics, but on the latitude of a certain area as well, the uncorrected potential evapotranspiration is corrected, and thereby the second parameter, the corrected potential evapotranspiration (*PE*) is determined. It is equal to 722 mm in Bačka Palanka area. The actual evapotranspiration (*AE*) is the real quantity of water which is released by transpiration from the plant or evaporates from the soil when it reaches the optimal humidity. It depends on both the energy-temperature conditions and the quantity of precipitation, and in this instance it is equal to 624 mm.

The humidity excess occurs not only at the beginning of the year, in January, February and March, but in December as well, and it is equal to 60 mm (as it does not occur during the growing season, it is of lesser importance to the plant). The lack of water, which is equal to 164 mm, occurs in July, August and September, and has an adverse effect on plant increment (Table 3, Graph 1).

TABLE 3
Hydrological balance according to Thornthwaite (1981-2010.)

	T (°C)	i	(PE)	PE	P	R	AE	M	V
I	0.2	0.01	0	0	38	100	0	0	22
II	1.6	0.18	4	3	31	100	3	0	28
III	6.4	1.45	22	23	39	100	23	0	16
IV	11.8	3.68	48	54	48	94	54	0	-6
V	17.3	6.53	78	103	62	53	103	0	0
VI	20.1	8.22	95	122	85	16	122	0	0
VII	21.9	9.38	106	143	64	0	81	63	0
VIII	21.6	9.17	104	130	56	0	56	74	0
IX	16.9	6.34	76	79	51	0	51	28	0
X	11.8	3.65	48	46	51	5	46	0	0
XI	5.9	1.29	20	16	52	42	16	0	0
XII	1.5	0.16	3	3	46	84	3	0	0
YEAR	11.4	50.06	603	722	624		558	164	60
V.P.	18.3			632	367		467	164	-6

Index humid.= 8.26381 Index aridn.= 22.7102 Climate index =-5.3623 DRY SUBHUMID CLIMATE – (C1)



GRAPH 1
Climate diagram according Thornthwaite for the weather station Rimski Šančevi, 1981-2010

TABLE 4
Humidity index (I_h), aridity index (I_a), climate index (I_c) and climate types determined by using Thornthwaite's method for the weather station Rimski Šančevi, 1981-2010.

Year	I_h	I_a	I_c	Climate type
1981	0	81.4171	-48.85	ARID - (E)
1982	11.2856	38.3661	-11.734	DRY SUBHUMID - (C1)
1983	-15.596	34.4147	-36.245	SEMI-ARID - (D)
1984	3.40306	19.1265	-8.0729	DRY SUBHUMID - (C1)
1985	11.5023	31.8364	-7.5996	DRY SUBHUMID - (C1)
1986	-1.3681	37.3262	-23.764	SEMI-ARID - (D)
1987	38.9877	39.7391	15.1443	MOIST SUBHUMID - (C2)
1988	7.90701	47.416	-20.543	SEMI-ARID - (D)
1989	-22.375	29.5854	-40.126	ARID - (E)
1990	-1.658	40.4085	-25.903	SEMI-ARID - (D)
1991	14.6262	3.76397	12.3678	MOIST SUBHUMID - (C2)
1992	9.0862	46.425	-18.769	DRY SUBHUMID - (C1)
1993	11.4399	48.3845	-17.591	DRY SUBHUMID - (C1)
1994	3.97241	28.7569	-13.282	DRY SUBHUMID - (C1)
1995	17.7248	21.7483	4.67585	MOIST SUBHUMID - (C2)
1996	21.9714	8.5633	16.8334	MOIST SUBHUMID - (C2)
1997	26.6338	15.9019	17.0927	MOIST SUBHUMID - (C2)
1998	5.67084	6.53068	1.75243	MOIST SUBHUMID - (C2)
1999	25.9862	1.74614	24.9385	MILD HUMID - (B1)
2000	-20.101	63.2524	-58.053	ARID - (E)
2001	46.2976	9.2512	40.7468	MODERATE HUMID - (B2)
2002	-7.3209	37.7059	-29.944	SEMI-ARID - (D)
2003	8.07373	48.8476	-21.235	SEMI-ARID - (D)
2004	31.9326	15.7893	22.459	MILD HUMID - (B1)
2005	5.36094	3.9467	2.99292	MOIST SUBHUMID - (C2)
2006	4.45894	21.3758	-8.3665	DRY SUBHUMID - (C1)
2007	23.7785	26.9406	7.6141	MOIST SUBHUMID - (C2)
2008	-5.1799	31.46	-24.056	SEMI-ARID - (D)
2009	13.887	38.8102	-9.3992	DRY SUBHUMID - (C1)
2010	43.234	0	43.234	MODERATE HUMID - (B2)
1981-2010	8.26381	22.7102	-5.3623	DRY SUBHUMID - (C1)

Climate index determined by using Thornthwaite's method

In the Table 4 are shown the values of the humidity index (I_h), aridity index (I_a) and climate index (I_c) in Bačka Palanka area regarding the observed period, as well as climate types determi-ned by using Thornthwaite's classification [17]. These data are important for the comparative analysis with the trends of the current diameter increment of Taxodium. The average general climate index in Bačka Palanka area over the period 1981-2010 is -5.3623, and the climate type is subhumid dry (C1). The average general index ranges from -58.053 (in 2000) to 43.234 (in 2010), i.e. the climate ranges from arid (E), to moderate humid (B2).

Diameter increment

Analysis of the average current diameter increment of Taxodium trees per years over the observed period

TABLE 5
Correlation matrix

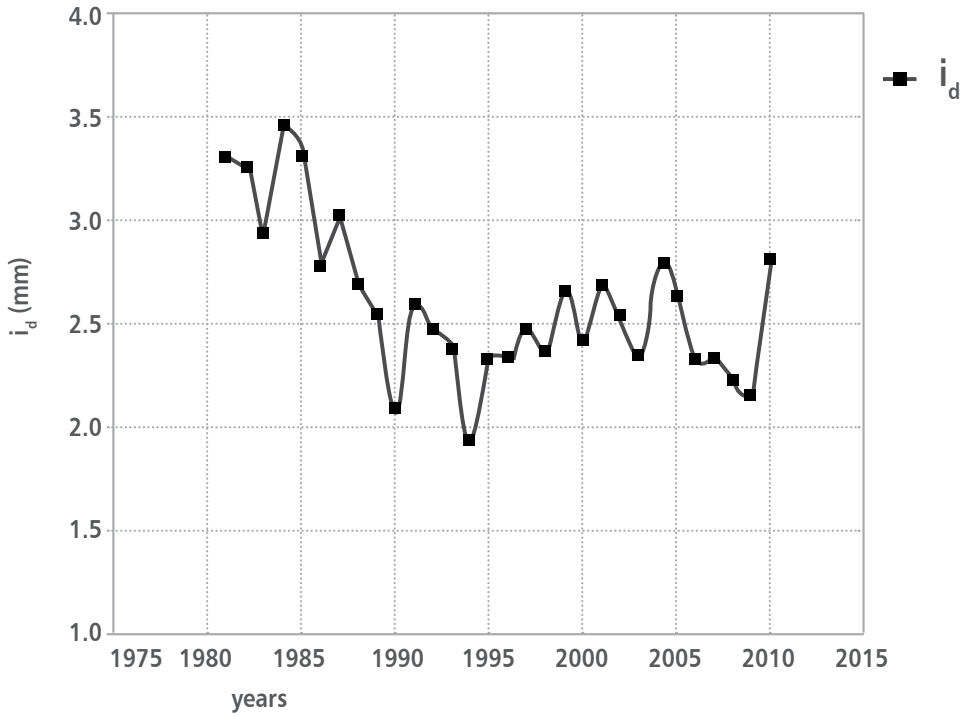
	i_d	p	t	i_c	p_v	t_v
i_d		0.1485	-0.5179	0.0243	0.1668	-0.4191
		0.4335	0.0034	0.8987	0.3784	0.0211
p	0.1485		-0.3206	0.8323	0.9240	-0.4061
	0.4335		0.0841	0.0000	0.0000	0.0260
t	-0.5179	-0.3206		-0.3751	-0.3566	0.7518
	0.0034	0.0841		0.0411	0.0531	0.0000
i_k	0.0243	0.8323	-0.3751		0.7820	-0.3807
	0.8987	0.0000	0.0411		0.0000	0.0379
p_v	0.1668	0.9240	-0.3566	0.7820		-0.4822
	0.3784	0.0000	0.0531	0.0000		0.0070
t_v	-0.4191	-0.4061	0.7518	-0.3807	-0.4822	
	0.0211	0.0260	0.0000	0.0379	0.0070	

shows the expected growth, but also significant oscillations in years when climatic conditions were the most important site factor which directly influenced the variations of the elements of growth.

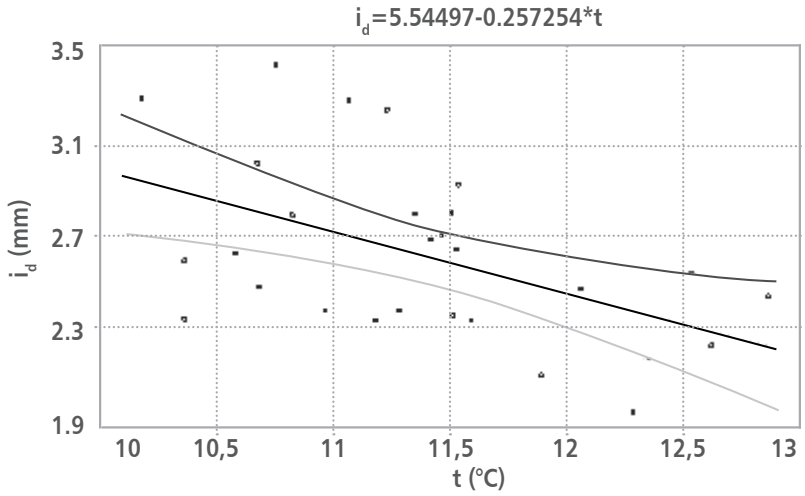
The size of average current diameter increment of Taxodium trees ranges from 1.92 mm in 1994 to 3.46 mm in 1984, and annual average value is 2.61 mm (Graph 2).

The impact of the climate elements on the diameter increment

The values of correlation coefficients, presented in the correlation matrix (Table 5), show that there is a correlation between trends of current diameter increment (i_d) and climatic parameters (annual amount of precipitation - p, mean annual temperature - t, amount of precipitation in the growing season - p_v, mean temperature during the growing season - t_v and



GRAPH 2
Current diameter increment (i_d) of Taxodium trees, 1981-2010.



GRAPH 3
The impact of the mean annual temperature (t) on the diameter increment (i_d)

climate index - i_c). On this basis it can be concluded that the climate is an important site factor that directly influenced the course and the variation of current diameter increment.

The correlation between the amount of annual precipitation and diameter increment is positive, but this relationship is not in the range of significance (Table 5). With increasing of amount of precipitation, the value of the current diameter increment is also increased.

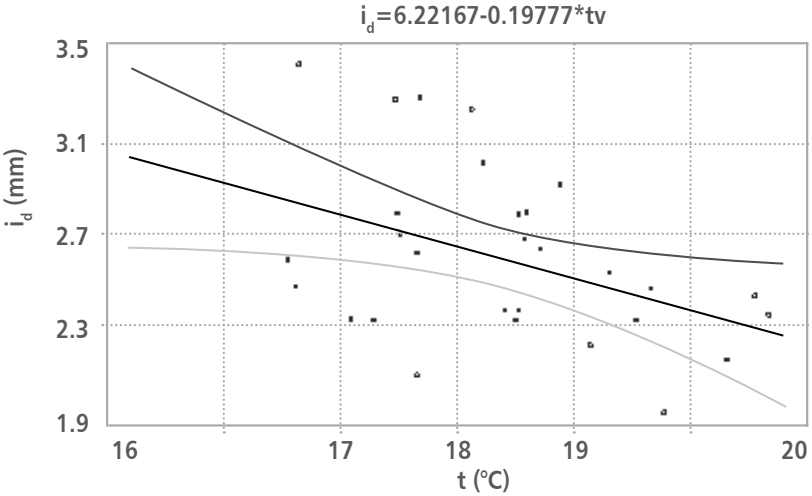
Mean annual temperatures have a greater impact on the value of the current diameter increment, the correlation coefficient is negative, and the relationship is in the range of significance (Table 5, Graph 3). With increasing of mean annual temperatures, the size of the current diameter increment decreases.

The correlation coefficient between the climate index and diameter increment is positive, but this relationship is not in the range of significance (Table 5).

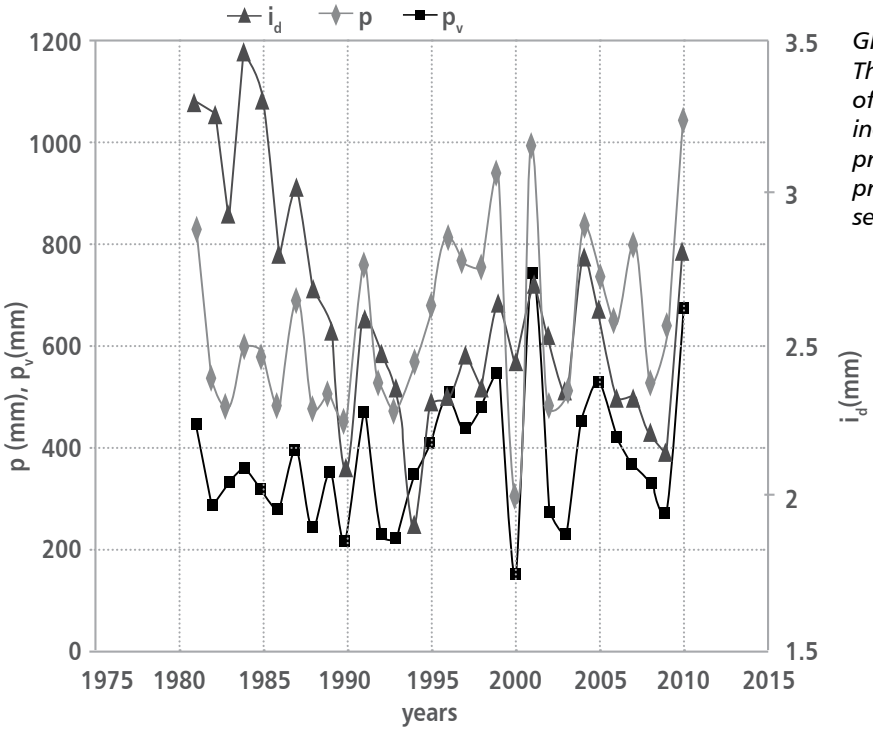
Value of the correlation coefficient between the amount of precipitation in the growing season and diameter increment is positive, but it is not in the range of significance (Table 5). With increasing of amount of precipitation, the size of the current diameter increment increases.

The influence of high temperatures during the growing season on diameter increment is more clearly defined. The correlation coefficient is negative, and it is in the range of significance (Table 5, Graph 4). With decreasing of temperature values, the value of diameter increment increases.

In Graph 5, which shows the fluctuations of diameter increment, precipitation (annual and in growing season), it is evident that the line of the current diameter increment follows the fluctuation of the annual



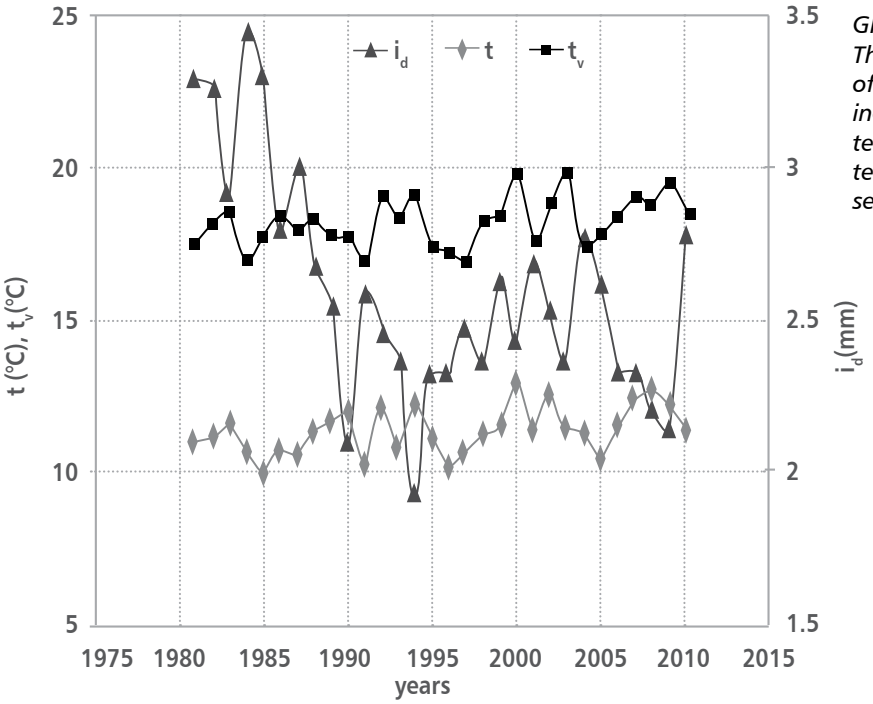
GRAPH 4
The impact of the mean temperature during the growing season (t_v) on the diameter increment (i_d)



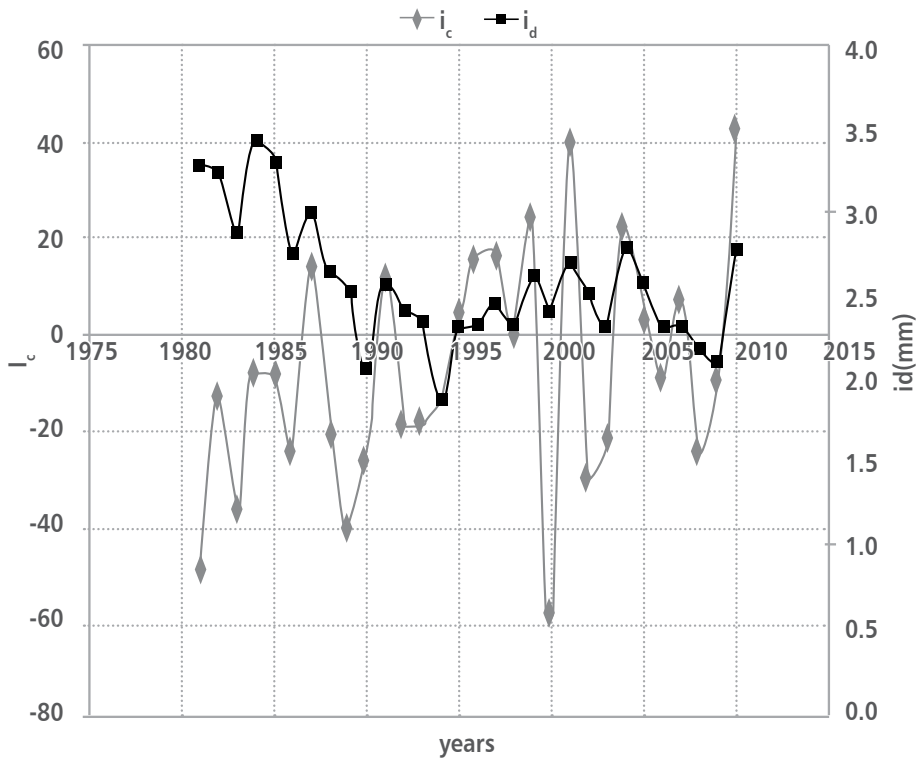
GRAPH 5
The correlation of the trend of the current diameter increment (i_d), annual precipitation (p) and precipitation in the growing season (t_v)

sum of precipitation and precipitation in the vegetation period per years of the observed period. With increasing of amounts of precipitation during the year, especially in the growing season, the diameter increment increases, and vice versa.

In Graph 6, which shows the fluctuations of diameter increment, mean annual temperatures and mean temperatures in the growing season, it is evident that with the increasing of the temperature the size of the diameter increment decreases, and vice versa.



GRAPH 6
The correlation of the trend of the current diameter increment (i_d), mean annual temperatures (t) and mean temperatures in the growing season (t_v)



GRAPH 7
The correlation of the trend of the current diameter increment (i_d) and climate index ($i_ç$)

In Graph 7, which shows the fluctuations of diameter increment and climate index it is evident that their correlation exists.

The following authors had similar conclusions in their researches with other species: with Austrian pine (*Pinus nigra* Arn.) Tokar and Krekulova [12] in Slovak Republic, then Koprivica and Matović [13] in Ibarska Gorge in Serbia; Vukin and Isajev [14] on Mount Jelova gora in Serbia; with Scots pine (*Pinus sylvestris* L.) Zafirov [11] in area of Vitosha Mountain, Bulgaria, then Kilgore and Telewski [10] in Northern Michigans, North America; with spruce (*Picea abies* L.) Wimmer and Grabner [9] in Eastern Ore mountains in Germany, Kilgore and Telewski [10] in Northern Michigans, North America.

CONCLUSIONS

Based on the research of the impact of the climate elements on the current diameter increment of the Taxodium trees and the obtained results, the following conclusions are made:

- The climate is the important site factor that directly influenced the fluctuation and the variation of current diameter increment.
- The values of the correlation coefficients show that there is a correlation between the trends of the current diameter increment and annual sums of precipitation, mean annual temperatures, sums of precipitation in the growing season, mean temperatures in the growing season and climate index.

The increase of the mean annual temperatures and mean temperatures during the growing season leads to the decrease of the diameter increment. The increase of the quantity of precipitation over a year, particularly during the growing season, leads to the increase of the diameter increment, and vice versa.

It implies that Taxodium as the species that grows on moist stands is able to react to the increased humidity as one of the most important site factors, upon which the growth of the basic quantitive tree parameters directly depends.

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Commercial Profitability of Poplar Plantation with Reference to the Damages Caused by Fungi

Ljiljana Keča

Faculty of Forestry
University of Belgrade
Kneza Višeslava 1
11030 Belgrade
Serbia
E-mail: ljiljana.keca@sfb.bg.ac.rs

Nenad Keča

Faculty of Forestry
University of Belgrade
Kneza Višeslava 1
11030 Belgrade
Serbia

Abstract

Background and purpose: Due to the fact that poplar rotation is one of the shortest in forestry, and as production of poplar wood requires rational and well-planned management, the potentials of sites and species must be maximally utilised. The main characteristics of the procedure of investment in poplar cultivation, is the fact that the conditions for the beginning of production and their exploitation are not created simultaneously. The main goal of the work reported in this paper was to examine the financial effects of different discount rates on the cost-efficiency values of studied poplar plantation, based on an analysis of the present value of costs and revenues over a stated time period using different methods of investment appraisal.

Material and methods: Investment Appraisal also known as Capital Budgeting is used to asses whether capital expenditure on particular poplar plantations will be beneficial for the entity or not. The investigated plantation was established from Populus x euramericana cl.I-214 *on alluvial semigley, with planting spacing 6 x 3 m, aged 26 years, for technical wood production. The data used in this study were collected from the archives of the, according to the age at plantation established and from the management and materials books of the forest enterprise "Vojvodinašume". During two-year study, the material was collected from study plot in order to assess the density, distribution and significance of individual fungal organisms present in the plantation. Identification was based on the morphological characteristics of species.*

Results and conclusions: Under the calculation discount rate of 12%, the project for the production cycle of 26 years was not cost-effective from the economic aspect. The discount rate of 6% can be accepted in this studied plot because of the better sites (alluvial semigley) and youngness of the stand. For the studied sample plot IRR is 6.94. R for the r=12% in the study compartment is 0.407. The analysis shows that PBP is practically unacceptable for the investor under the discount rate of 6%. In the studied plot altogether 11 species of fungi causing significant damages in hybrid poplar plantations were identified. Two were found on cortical tissue, 6 on leaves and 3 species are causing decay. Number of trees attacked with decaying fungi, like Fomes fomentarius, Trametes suaveolens, was bellow 2%/ two percentage.

Keywords: hybrid poplar plantations, investment appraisal, commercial profitability, costs, revenues, diseases, decline.

INTRODUCTION

The economics of growing hybrid poplar is a difficult subject that has been studied by many for years, but it depends upon so many ever-changing variables [1-6]. It is complex because the revenues from a multi-year poplar crop are not generated until harvest and the costs to establish and maintain the crop occur long before rotation age [5]. Moreover, the costs vary markedly with soil type, productivity, location including distance from markets, fossil fuel costs, government programs and landowner objectives. There are

also many risks in growing poplars including weather, pests and diseases [4]. Poplar plantations are a category of fixed assets in forestry, i.e. the assets with a biological character [7-9]. The commodity nature of most forest plantation products - either fibre for pulp production, or utility grade timber - or the increasing globalisation of markets for these products maintains strong price pressure in favour of the lowest cost producers. Production costs are determined by the inescapable trio of land, labour and capital costs, and by forest productivity. The inevitable consequence of these pressures is the trend towards shorter crop rotations, which have been facilitated by advances in processing technologies, and the search for enhanced productivity [10].

Due to the fact that production of poplar wood requires rational and well-planned management, the site and the species potential have to be maximally utilised. Also it is very important to realize the favourable financial effects of such a production. Poplar wood production in plantations of different characteristics is one of the shortest rotations in our circumstances [8]. They are related to their site, cultivated for a relatively long time and have a relatively long utilisation cycle, with the yield development determined by the plantation growth and age.

The investment process in poplar wood production includes financial investments in present to achieve economic benefits in the future, and have seasonal characteristics. Plantations transfer their value gradually to the obtained products during the period of their harvesting, and, by the realisation of the products, the means invested in the plantation establishment are reproduced [9, 10]. Therefore, it is possible some problems can arise, mainly in a framework of forecasts, calculation of investments in poplar production, engagement of human labour, mechanical work, etc. [11].

Yield classes in hybrid poplar plantations (*P. x euramericana cl. I-214*) are high in Serbia. But, the economic cost-effectiveness of the poplar plantations is debatable, due to the high costs encountered at the stage of plantation establishment (chipping of tree stumps, ploughing, planting, protection, etc.) [12].

Presence of pests and diseases can cause reduction of increment and vitality in fast growing hybrid poplar plantations [13]. Depending on the environmental conditions and inoculums potential of pathogenic or saprophytic fungi damages can vary from year to year [14]. Appropriate use of pesticides and less susceptible cultivars can minimize losses of production. Cultivar *I-214* is very productive, but requires optimal conditions and very intense protection against pests and diseases, especially *Cryptodiaporthe populea* (Sacc.) Butin [15] and leaf diseases [16].

The goals of the work reported in this paper were: (i) to examine the financial effects of different discount rates on the cost-efficiency values of poplar plantations, based on an analysis of the present value of costs and revenues over a stated time period, (ii) to assess influence of pests to the financial outcomes of plantation and (iii) to test the sensitivity of these values to possible changes in the levels of costs and revenues.

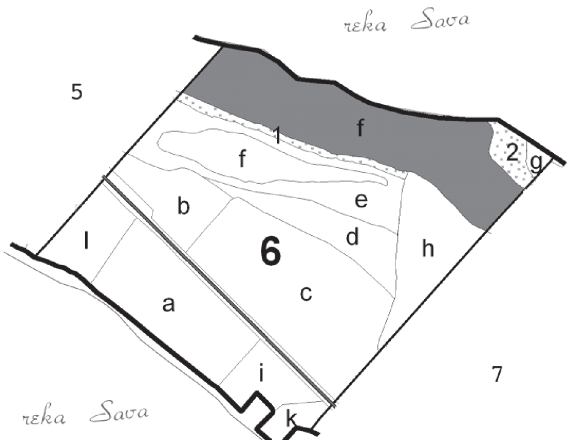
MATERIAL AND METHODS

The period of investments in poplar growing can be relatively long, and so is the period of harvesting. Therefore, it is important to determine the time of return the capital (pay back period - *PBP*) invested in these and similar plantations, current value of cash flow which is equal to the current value of the cast outflow (internal rate of return - *IRR*), difference between current values of the future incomes and costs of the projected plantations (net present value - *NPV*), and value the degree of profitability when we compare the degree of incomes and outcomes (benefit-cost ratio – *R*).

The data used in this study were collected in two, main phases. Data pertaining to costs during years 0-5 (soil preparation, planting, care and protection, etc.) were obtained from the archives of the forest enterprise which managed the studied plantations Public Forest Enterprise "Vojvodinašume", according to the age at plantation established [8-12].

Cash outflow is present in the first 5 years, and cash inflow from schematic thinning in 6th years and at the end of rotation (in this case at age 26) (Table 1). In the second phase data were collected from the management and materials books of the forest enterprise. Costs and receipts of wood production of the clone poplar *I-214* were investigated in one management unit in (F.E. „Sremska Mitrovica", PE "Vojvodinašume"). The stand 26 years old, planting density 6x3 m, forest type poplar on alluvial semigley, with a total area of 9.78 ha (Map 1). The purpose of this stand is production of technical wood. Costs are expressed per unit area 1 ha at the prices in force in January 2010, converted into euro (€). Since, all studied stands are state-owned and managed by the Public Forest Enterprise "Vojvodinašume", the value (cost) of the land (land rent) did not enter into the calculations [17].

The aim of the study was to check the justification of the invested financial means in artificial poplar



MAP 1
Studied plot (compartment f)

plantations, based on the analysis of costs and receipts in the rotation of 26 years, on alluvial semigley, at different discount rates (4-12%), by using the method of analysis of commercial profitability, especially some methods of dynamic investment calculation (*NPV, IRR, R, PBP*) [12].

The NPV method calculates the present values for all future cash flows [12, 18, 19].To determine the value of the discount rate at which *NPV* investment is zero, it has been used *IRR*. Payback period calculates the time taken by a project to recoup the initial investment [12, 20]. All benefits and costs should be expressed in discounted present values i.e. benefit-cost ratio [12, 21].

Sensitivity analysis is useful for adjustment of changes in current values of costs and receipts in a range 70-130%. Using this analysis clearly is defined changes in financial profitability of the raising of poplar plantations; however it can be obtained the results which point out the positive or negative effects. It can be useful in forestry practice to channel management activities to find out the solution for achievement of the best results in a framework of financial results [22].

The dynamic methods are nowadays used in all countries over the world in the investment economics effectiveness appraisal and start with the assumption that money has its time value, i.e. the certain amount of money does not have the same value today and in a certain future moment of time, which is very important particularly in forestry where the rotations are very long.

During two-year study, the material was collected from study plot in order to assess the density, distribution and significance of individual fungal organisms present in the plantation. Identification was based on the morphological characteristics of species as described by Keča [23]. The estimation of damages caused by different species was according to the Karadžić [24].

Treatment costs consisted of the product price and labour cost. The cost of labour and mechanization was estimated directly in the field and added to the cost of establishment and maintenance of plantation.

RESULTS

The access to the main data (Table 1) point out the duration of rotation period is 26 years; stand costs are present in first 6 years and in the 26th year of the stand (final cut). In the age of seventh there is small income, and on the end of the rotation we have pre final income of 16 236.58 € ha^{-1}.

Net present value, by the discount rate of 12% is $NPV=\sum P_r - \sum T_r = -1\ 585.84$ € ha^{-1}. Based on this fact it

TABLE 1
Assortment structure and income from the studied poplar plantation

Classes	Assortment structure		Price	Value of assortments by official price list
	m^3	m^3·ha^{-1}	€·m^{-3}	€·ha^{-1}
F veneer	1 524.51	154.46	55.00	8 495.24
L–peeling logs	759.70	76.97	45.00	3 463.68
Timber wood class I	545.66	55.28	35.00	1 934.96
Timber wood class II	493.22	49.97	27.50	1 374.22
Pulpwood	557.69	56.50	17.14	968.47
Total	3 880.78	393.19	/	16 236.58

can be concluded that the project is not profitable for the rotation of 26 years and discount rate of 12%, due to the fact that it is in the loss of approximately 1 600 € on the end of the rotation (Table 2). However, it could be find the solution in calculation with the lower discount rate or investigate the possibility to short the rotation.

Based on the application of the **susceptibility analysis**, it was concluded that there was an option to realise the positive financial effect by decreasing the costs, or by increasing the receipts. Sensitivity analysis show how the project is responding to cost and receipts changes by varying of cost/receipts in the range of ±30% (in the step of 5%). The future of the project can be clearly defined by using this method in the framework of risk analysis (Table 3).

It has been determined that for the r=12%, project is profitable if it can be realise the incomes more than 2.1 times (330%) or to reduce costs for 56%. For r=8% it is necessary to diminish costs for 12% and in that case investment can cover costs from incomes. Alternative way is than in the current circumstances, income can be increase for about 18%. For r=6% by the current circumstances and receipts, it is necessary to increase costs for about 15% and in that case investment can cover the costs from the incomes. It is possible to reach the same financial effect by decreasing of incomes for about 12%. For r=4% it is possible that investment can cover the costs from the incomes for the increasing of the costs for about 55%. By the current costs and present situation it can increase of the incomes for 36% (64% from realised) try to supply the same financial effect. The results clearly direct to the fact there is the reverse proportion between the discount rate and age of the stand (Table 3).

Internal rate of return is 6.94. It can be concluded that the annual rate of profit is just 6.94% from the whole capital expenditures. Due to this fact it can be concluded that this project cannot pay off the potential loan and the solution can be find in reduction of discount rate on less than 6.94%. Sensitivity analysis shows that the stand is very susceptible to changes of incomes and outcomes. Decreasing of costs and increasing of revenues for 30%, value if IRR ranged 9.26 (T_r) and 8.64 (P_r) (Table 4).

In this sample plot there has not been noticed the values of *IRR* higher than 12% in researched interval of changes in costs and revenues. They are realized in the level below 70% from realized costs (≤46.7%) or above 130% from realized revenues (≥213.9%).

Benefit - cost ratio for the r=12% in the researched plot range of *Tr* and *Pr* is lower than 1. In the study compartment this ratio is 0.407. Accordingly, it can be asserted that it is economically unjustified to invest in the projected stand, but only in the case when the value of social capital accounts for 12%. Based on the analysis of sensitivity of the cost-benefit method, it was concluded that cost benefit ratio for r=8-12% was below 1 within the study range of costs and receipts changes, while for r=4-6% this ratio was above 1 in some cases of decrease in costs, i.e. increase in receipts. It was noted that the change in p depending on the change in costs, developed by the exponential function, and the change in r depending on the change in receipts developed by

TABLE 2
Receipts and costs of the wood production project in poplar plantation for r=12%

Year	Costs	Receipts	Real C	Real T	Cost	Receipts	∑Pr – ∑Tr
	T	P	T_r	P_r	$\sum T_{rs}$	$\sum P_{rs}$	
	€						
0	2040.48	0	2040.48	0	2040.48	0	-2040.48
1	209.44	0	187.00	0	2227.48	0	-2227.48
2	177.97	0	141.88	0	2369.36	0	-2369.36
3	111.65	0	79.47	0	2448.83	0	-2448.83
4	96.9	0	61.58	0	2510.41	0	-2510.41
5	96.9	0	54.98	0	2565.39	0	-2565.39
6	442.22	1064.2	224.04	539.16	2789.43	539.16	-2250.28
26	3585.44	16236.34	188.31	852.75	2977.74	1391.90	-1585.84
∑	/	/	2977.74	1391.90			-1,59

TABLE 3
Susceptibility of NPV depending on relative changes of T_r and P_r (r=4-12%)

Rate of change	r=12%		r=8%		r=6%		r=4%	
	T_r	P_r	T_r	P_r	T_r	P_r	T_r	P_r
%	000 €							
70	-0.69	-2.00	0.50	-1.37	1.70	-0.72	3.68	0.38
75	-0.84	-1.93	0.33	-1.23	1.51	-0.50	3.46	0.71
80	-0.99	-1.86	0.16	-1.08	1.33	-0.28	3.25	1.05
85	-1.14	-1.79	0.00	-0.94	1.14	-0.07	3.03	1.38
90	-1.29	-1.73	-0.17	-0.80	0.95	0.15	2.82	1.72
95	-1.44	-1.66	-0.34	-0.65	0.77	0.36	2.60	2.05
100	**-1.59**	**-1.59**	**-0.51**	**-0.51**	**0.58**	**0.58**	**2.39**	**2.39**
105	-1.73	-1.52	-0.68	-0.37	0.39	0.80	2.17	2.72
110	-1.88	-1.45	-0.85	-0.22	0.21	1.01	1.96	3.06
115	-2.03	-1.38	-1.02	-0.08	0.02	1.23	1.74	3.39
120	-2.18	-1.31	-1.19	0.06	-0.17	1.44	1.52	3.73
125	-2.33	-1.24	-1.35	0.21	-0.35	1.66	1.31	4.06
130	-2.48	-1.17	-1.52	0.35	-0.54	1.88	1.09	4.40
Condition for $\sum P_r - \sum T_r = 0$	**46.74**	**213.93**	**84.88**	**117.81**	**115.51**	**86.57**	**155.36**	**64.37**

the linear function Therefore it can be claimed that economically is unacceptable to invest in such a stand, but just when r= 12%. Sensitivity analysis of *R* was also carried out for *r* = 8–12% in the range of changes of costs and receipts lower than 1. For *r* = 4–6% there are cases where this ratio is above 1. Thus, it seems better to focus efforts on reducing the discount rate, respectively.

Statistical significance is verified by t-test, correlation coefficient, determination coefficient, and Fisher's statistics for changing of costs and receipts. It can be concluded that the connection of relative and independent variable very high $R \geq 0.94$, the ratio between explained and total variations in the regression is very high $R^2 \geq 0.9$. Fisher test confirm i.e. test the precision of calculated correlation coefficient. That value is also very high, therefore it can be proven the fact that we can have confident in the calculated coefficient of cor-

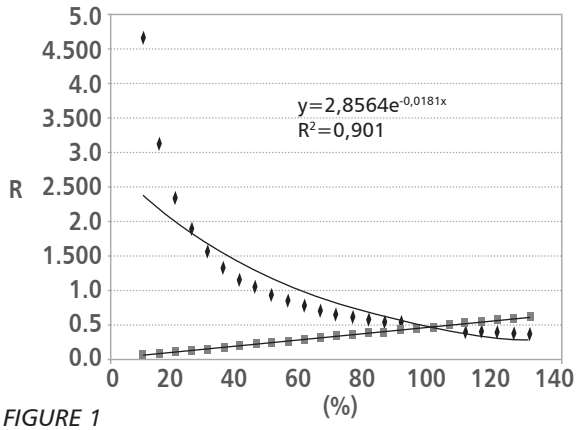


FIGURE 1
Changes in the benefit-cost index (R) in relation to relative changes in costs (C_r) and revenues (R_r) at the discount rate r=12% for studied plot

TABLE 4
Sensitivity of IRR in a ratio changes of T_r and P_r in the range of 70–130% (r =12%)

P_r	T_r	IRR	T_r	P_r	IRR
%					
100	70	9.26	100	70	4.58
	130	5.22		130	8.64
Condition for IRR = 12%	46.74%			213.93%	

relation. Using t-test it is established the fact that the precision of the calculated parameters and it is proven that the parameters are very precise calculated in all examples (Table 5).

TABLE 5
Statistics analysis for the studied sample plot

Changes of T	Values	Changes of P	Values
R	0.949	R	0.9999
R^2	0.901	R^2	0.9999
F-statistics	209.3	F-statistics	7928443
t-statistics	10.67	t-statistics	- 0.51
$y = 2.856 \cdot e^{-0,0181x}$		$y = 0.0047x + 0.00007$	

Application of the **pay back period** (*PBP*) calculation can affect greatly the reliability of predicting the degree of economic effectiveness of investments, and also the potential risks for the investor in his decisions on investments in poplar cultivation. In this procedure, the paper does not apply the recognized calculation rate of 12%, which is usually applied worldwide, but the rates of 6%, 4% and 2%. The most favourable situation is the discount rate of 2%, where the *PBP* is 12 years. The analysis shows that *PBP* is practically unacceptable for the investor under the discount rate of 6%. The susceptibility of *PBP* in this case was analysed by varying the costs within 10-100%, and the receipts between 100-550%. Based on the analysis of susceptibility for the method of pay back period, it can be concluded that the change in receipts and costs in 5% steps can be represented by an exponential function and that *PBP* is between 1.3-4.6 years. For r=2% this ratio is the most favourable both in the case of the changes in receipts and the changes in costs [12].

Altogether 11 species of fungi causing significant damages in hybrid poplar plantations were identified. Two were found on cortical tissue, 6 on leaves and 3 species are causing decay. In one to two years old plantations trees were destroyed by *Dothichiza populea* and on dryer sites by *Valsa sordida*. Approximately 9% of costs for replanting of plantation were attributed to these two pathogens.

From the second year fungi attacking leaves *Melampsora* spp. and *Marssonina brunnea* directly influence diameter and height increment. Performed treatments with chemical agent Bakarni kreč – copper oxychloride (Zorka Šabac, Serbia) and captan fungicides reduced attack to moderate, so there was no significant reduction in biomass production.

Number of trees attacked with decaying fungi, like *Fomes fomentarius*, *Trametes suaveolens*, was bellow 2% two percentage (Table 6). Trees with decay could not be used for assortment production, which caused decrease of revenues. On the other hand decayed trees were used for biodiversity sustain, which is obligatory in FSC certified forests.

TABLE 6
Diseases causing decline in poplar plantations establishment and protection

No.	Species	Plant parts colonized	Significance
1.	*Cryptodiaporthe populea* (Sacc.) Butin (anamorph *Dothichiza populea*)	Branches and trunk	+++
2.	*Marssonina brunnea* (Ell. et Ev.)P. Magn.	Leaves and sprouts	+++
3.	*Melampsora allii-populina* Kleb.	Leaves	+++
4.	*Melampsora larici-populina* Kleb.	Leaves	+++
5.	*Phyllosticta populorum* Sacc. et Roum.	Leaves	++
6.	*Pollaccia elegans* Serv.	Leaves and sprouts	+
7.	*Taphrina aurea* (Pers.) Fr.	Leaves	+
8.	*Valsa sordida* Nitschke	Branches and trunk	+++
9.	*Fomes fomentarius* (L.) Fr.	Trunk	+++
10.	*Pholiota populnea* (Pers.:Fr.) Kuyper & Tjallingii-Beukers	Assortments and stumps	+++
11.	*Trametes suaveolens* (L.) Fr.	Trunk and branches	+++

(-) Typical saphrotrophes; (+) present often, low economic impact; (++) very often present in plantations, exceptionally cause practical problems; (+++) practical problem in maintenance of poplar plantations.

DISSCUSION

Poplar plantations have a high productivity and, in terms of forestry, short rotations (10-25 years). But, their economic profitability is far less than that found in industry and agriculture [18, 6]. Serbia produces around 350 000 m^3 of poplar wood, which is much less than the world greatest producers like China, France, India, Italy and Turkey [25].

On the other side, long production cycles, provide low values for *NPV*, even for the discount rate of r=4%. Based on the above, it is clear that, in practice, it is necessary to improve the position of production in getting the deficient financial means for investments in poplar cultivation, in order to stimulate establishment of artificial poplar plantations, especially in the private sector [26]. Investments can be directed in cost reduction for: soil preparation (stump chipping, deep ploughing, etc.), improvement of inter-row tilling, better plant protection against insect pests and pathogenic fungi [27] Additional income and cost reduction can be obtained by using remaining poplar wood for biomass [28], which is in line with the Common Agricultural Policy of the European Union and endeavours of the Government of the Republic of Serbia to develop the bioenergy sector [29]. However, it is clear that the results have practical application, as they show in which interval poplar plantations are profitable.

It is also very important to mention that poplar plantations can not be profitable at discount rates in the range 10-15%, as used in assessing funding opportunities in the economies of developing and transition countries [30]. The values of *IRR* in the work of various authors range from 4.3% [31] through 6-10% [32] up to 12-15% [33, 34] for poplar plantations. In our studied plot it is 6.94. The costs of logging and assortment production make a significant expense item; an increase in costs of 20-40% (which can be expected due to the uncertain changes in the price of fuel and lubricants) may cause the *IRR* to increase by 2% [1]. These observations provide space for cost reduction in the felling and preparation of assortments and in the first phase of transport by wider use of automation (processors and "grinders"), or by transforming the entire timber mass into biomass [35, 36].

Average „benefit-cost" value is in the range from 0.4 to 2.8 [37] and our studied plot is it 0.407.

Different authors analyze different *PBP* for poplar plantations depending on the soil type, age of stand, plant density and climate. In India Dhillon et. al. [38] mention *PBP* of 7 years, Chandra about 10 years [39], McKenney in the range 10-22 years [40] and Latif et.al. [41] mention 15 years for poplar plantations in Malaysia.

Only application of all four methods gives solutions to investment issues in poplar plantations in general. The observed characteristics, such as soil type and age, are the directions for the establishment of intensive poplar plantations in the future. It is also very important to mention that depending on the purpose of plantations and market conditions, it is necessary to shortened rotation period on 15-20 years in respect to the current prescribed period of 25 years of poplar plantations in Serbia.

The investments can be directed to: more efficient soil preparation (stump chipping, deep ploughing, etc.), improvement of inter-row tilling, better plant protection against insect pests and pathogenic fungi. On the sites unsuitable for poplar planting, it is recommended to apply fertilizers, branch pruning to the height as much as 6 to 8 m. All the above technical and technological measures, although classified as direct costs, contribute to the improvement of project efficiency, because they are directly reflected to the quality of assortments and their value at the end of the production cycle.

Based on the above, it is clear that the results have practical application, because shows in which interval poplar plantations are profitable. There are commercial banks in Serbia, where one can get a loan with interest rate of 5%. Private owners can be advised to invest in such a production of poplar wood. On the other side there is the interest of state regarding poplar plantations. Plantations are very efficient in CO_2 consuming, as shelterbelts, flood control, etc. Therefore, state can stimulate the forest owners to invest in poplar production in river banks in the future. The plantations grown on more quality soil types such as alluvial semigley are more profitable.

Nowadays, with the higher awareness of human impact on the environment, benefit/cost analysis is increasingly applied in the evaluation of forest social functions, wildlife conservation, impact on water resources (water supply, acidification and erosion control), landscape management, and greenhouse effect reduction. Forestry is often unable to valorize all of its products on the market, therefore the social community should support forestry, in a way, especially in the realization of the projects dealing with plantation forestry. One of the forms of support could be to enable the use of beneficial interest rates on the means invested in the establishment of new plantations, which are considerably lower than those in other production fields.

Losses from the pests and pathogens in hybrid poplar plantation are almost unavoidable [42]. Some year environmental conditions can speed up inoculum production and cause epidemic [43]. Because of high costs

of poplar plantation establishment all losses from pests and diseases must be kept as low as possible. Special attention must be devoted to the survival of seedlings in the first vegetation after planting. It was observed that under the moderate attack of leaf pathogens [44], as it was the case in this study, there is no significant loss of height and diameter increments [45, 13].

CONCLUSIONS

On the basis of the analysis performed using the *NPV* method, it can be concluded that the studied plot for the time period of 26 years was unprofitable, because the loss was about 1 586 €·ha^{-1}. Investments in the plantations of these rotations are acceptable only if the discount rates (4-6)%. Based on application of the susceptibility analysis, it was concluded that positive financial effects can be realized by decreasing costs, or by increasing receipts. The research showed that the *IRR* for sample plot is 6.94. Sensitivity analysis of *IRR* shows that the stand is very susceptible to changes of incomes and outcomes. The analysis shows that *PBP* is practically unacceptable for the investor under the discount rate of 6%. *R* is 0.407 at a discount rate of 12%, therefore it can be claimed that it is economically unacceptable to invest in such stand.

Application of intense protection measures during the first three years can prevent increase of costs by necessity for replacing dead trees. Further protection of leaves against pests and diseases can improve both tree conditions and prevent losses in height and diameter increment. Maximal production will result in as high income as it can be expected from the site potential.

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Practice-Oriented Yield Table for White Poplar Stands Growing under Sandy Soil Conditions in Hungary

Károly Rédei

Forest Research Institute,
Püspökladány Experimental Station
Farkassziget 3
Püspökladány 4150
Hungary
e-mail: redei.karoly@t-online.hu

Zsolt Keserű

Forest Research Institute,
Püspökladány Experimental Station
Farkassziget 3
Püspökladány 4150
Hungary

János Rásó

Forest Research Institute,
Püspökladány Experimental Station
Farkassziget 3
Püspökladány 4150
Hungary

Abstract

*Background and purpose: White poplar (*Populus alba *L.) and its most important natural hybrid, the grey poplar (*Populus x canescens *SM.) are native tree species in Hungary, covering 3.2% of the forested area. Thanks to their favourite silvicultural and growth characteristics as well as the wood utilization possibilities, their present area is increasing continuously. The most important task ahead of Hungarian poplar growers is to improve the quality and to increase the quantity of poplar stands for wood production. To determine their growth rate and yield as exactly as possible, a yield table has been constructed which is based on the currently applied silvicultural practice.*

Material and methods: Chapman – Richards function with three parameters was successfully used as a growth function for constructing the height growth model. The white poplar yield table was constructed from data gathered on 50 permanent and 40 temporary plots (cca. 500-1000 m^2). The age of the stands varied between 5 and 45 years. In the course of the stand surveys the key stand characteristics were measured, and then, on the basis of data collected, were calculated such major stand structure features as the average height, diameter (DBH), volume, basal area and stem number given separately for the main (remaining), secondary (removal) and total stands per hectare.

Results and conclusion: The numerical (tabulated) yield table of normative nature presents data given to six yield classes (base age: 25 years) including the most important stand structural and yield features expressing in terms of main stand, removing stand (which can be removed in tending operations) and the total stand. It is based on the Hungarian applied tending operations' practice. The published yield table has already been utilized in the field of the relevant forest inventory as well.
*Keywords: white poplar (*Populus alba *L.), Chapman – Richards function, yield table, Hungary*

INTRODUCTION

White poplar (*Populus alba* L.) and the grey poplar (*Populus x canescens*) are native poplar species in Hungary. Their area was 65000 ha in 2006 (3.2% of the total forested land), with a standing volume of 9.8 million m^3 (163 m^3 ha^{-1}).

More than 70% of the white poplar stands can be found on calcareous sandy sites on the Danube-Tisza region. Native poplars have been regarded for several decades as weed tree species without any value for timber market. In spite of this fact about 35% of the new afforestation and artificial regeneration is carried out presently with white poplar in the mentioned region. White poplar has a rich gene pool on the sand dune region in the middle of the Great Hungarian Plain and on the bottomland of big rivers [1, 2]. In the near future, due to the establishment of national parks in these regions, considerable increases can be expected in the area of native poplars. At the same time their importance will be increasing in the large areas of marginal sites which are not suitable for hybrid poplars but can accommodate native ones.

In the Danube-Tisza region some very important ecological factors have become unfavourable for poplar growing in the last two decades. There is no sufficient precipitation during the growing season (appr. 200-300 mm), and the rivers' control and canalisation have caused a drastic lowering of the ground-water table in many places. In such spots the water supply for poplars depends on the moisture content of soils, accumulating waters on the surface and on the water-storing capacity of soils [3, 4].

It should also be emphasized that white poplar is a fast-growing species which in the seedling age rises quickly form the weed competition. In the first years of the forestations established by seedling it must perform the in-line and inter-row weeding, as well as the cutting back of injured plants. During of its tending operations it is important to take into consideration, that its populations consist of trees of varied genetic value (genotypic). From the point of view of its light-demand the fact deserves attention, that while it endeavours extremely strongly to the light, on the other hand it tolerates excellently the shade too.

The considerable white poplar afforestation of the last decades is indicated by the fact, that the 75% (according to the area), respectively the 60% (according to the growing stock) of white poplar stands can be found on calcareous sandy sites in the Danube-Tisza region [5]. The average growing stock is 161 m^3/ha; the average final cutting age is 32 years.

The white poplar yield table compiled *to the area of the sandy sites* as regards its nature is the first in the history of the national white poplar research. The course of the compilation, which can be programmed, makes possible enlarging the information content of the yield table and also changing its form and content.

MATERIAL AND METHODS

The white poplar yield table was constructed from data gathered on 50 permanent and 40 temporary plots (cca. 500-1000 m^2) located in stands in the sandy ridges between the rivers Danube and Tisza (Figure 1). The age of the pure stands owned by state varies between 5 and 45 years and they have been managed on base of growth and silvicultural model for white poplar stands [3].

In the course of the stand surveys the key stand characteristics were measured, and then, on the basis of data collected, were calculated such major stand structure features as the average height, diameter (DBH), volume, basal area and stem number given separately for the main (remaining), secondary (removal) and total stands per hectare. Stem volume was estimated by the following volume function [6]:

$$v = 10^{a} d^{b} h^{c} \left(h/[h-1.3]\right)^{y} \left[-0.4236\, d\, h + 12.43\, d + 4.6\, h + 3298\right]$$

where v is stem volume (m^3), d is diameter at breast height (cm), and h is tree height (m).The regression analysis have been computed by the ANOVA statistical programme.

In the USA, South Africa and many other countries, the site index, site class or yield class of a stand is usually defined as the mean height of the dominants and co-dominants [7-10], at a reference age, which is closely

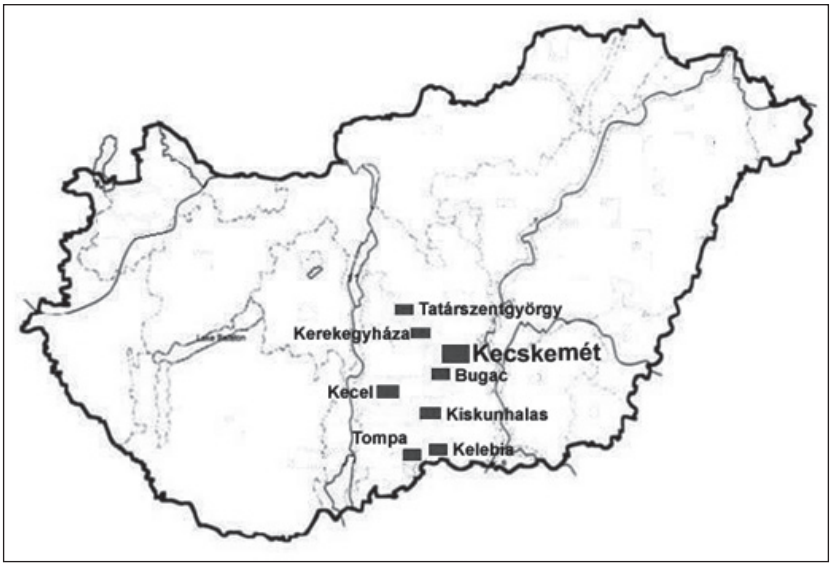


FIGURE 1
Locations of the sampling plots

linked with the rotation age. In Germany, the site index, which replaced the earlier site class concept, is defined as the regression height of the quadratic mean diameter of the 100 thickest trees per hectare at a reference age which is usually 100 years [11]. A much lower reference age is used for fast-growing stands and plantations, for example, 25 years for black locust (*Robinia pseudoacacia L.*) [12], and also 25 years were chosen for white poplar to construct the new yield table.

In Hungary the Chapman – Richards function [13] is the most frequently used function in the yield - (site -) dependent height growth model. It has three parameters a, b and c, which control the asymptote, slope, and the location of the function's inflection point. On base of this function a guide curve was fitted to the distribution of the average heights of main stands, plotted over age. This curve was used to generate a family of yield class curves on base of the reference age. The expected height values of the main stands at the reference age according to the yield classes are: 24.2 m, 21.6 m, 19.0 m, 16.4 m, 13.8 m and 11.2 m. According to the fitted guide curve and to the reference age (100%) a percentage value could be calculated at any ages and for any yield classes. The authors' yield table was constructed using the following formulas and coefficients (detailed dataset can be available at the authors):

1. Age of stand (A)

2. H_m = average height of main (remaining) stand (height of dominant and co-dominant trees) in m:

$$H = 1.21592 \times (1 - e^{-0.09236 A})^{1.2227}$$

3. D_m= average DBH of main (remaining) stand in cm:

$$D_m = 1.58356 + 0.73502 \times H_m + 0.01571 \times H_m^2$$

with R^2=0.886

4. V_m= volume of main (remaining) stand in $m^3\ ha^{-1}$:

$$V_m = BA_m \times H \times F$$

where $H \times F$ = form-height quotient

$$H \times F = 1.96791 + 0.40778 \times H_m$$

with R^2=0.923

5. BA_m= basal area of main (remaining) stand in $m^2 h^{-1}$:

$$BA_m = \frac{D_m^2 \times \Pi}{4 \times 10000} \times N_m$$

6. N_m= stem number of main (remaining) stand in ha^{-1}:

$$N_m = e^{8.71483 - 0.83879 \ln D_m}$$

with R^2=0.826

7. H_r= average height of removal stand in m:

$$H_r = 0.7 \times H_m$$

8. D_r= average DBH of removal stand in cm:

$$D_r = 0.7 \times D_m$$

9. V_r= volume of removal stand in $m^3\ ha^{-1}$:

$$V_r = BA_r \times H \times F_m$$

10. BA_r = basal area of removal stand in $m^2 h^{-1}$:

$$BA_r = \frac{D_r^2 \times \Pi}{4 \times 10000} \times N_r$$

11. N_r= stem number of removal stand computing from reduction of stem number of main crop in five year intervals in ha^{-1}

12. H_t= average height of total stand in m:

$$H_t = 1.14174 + 1.02809 \times H_m$$

with R^2=0.917

13. D_t= average DBH of total stand in cm:

$$BA_m = \frac{D_m^2 \times \Pi}{4 \times 10000} \times N_m$$

14. BA_t= basal area of total stand in m^2 x ha^{-1}:

$$BA_t = BA_m + BA_r$$

15. V_t= volume of total stand in m^3 x ha^{-1}:

$$V_t = V_m + V_r$$

16. N_t= stem number of total stand in ha^{-1} :

$$N_t = N_m + N_r$$

17. Cumulative volume of intermediate cuttings $= \Sigma$ total volume of removing stands in $m^3\ ha^{-1}$.

18. Cumulative total volume (ΣV_t)= volume of total

stand in age A + volume of removing stand in age *A – 5* in $m^3\ ha^{-1}$.

19. Mean annual increment of cumulative total volume $=(\Sigma V_t)\times A^{-1}$ in $m^3ha^{-1}yr^{-1}$. Due to the yield table construction followed by the authors, the culmination of the mean annual volume increment in each yield class can be found at the reference age.

20. Current increment of cumulative total volume = one year increment of (ΣV_t) in five year intervals in $m^3ha^{-1}yr^{-1}$.

RESULTS

The numerical (tabulated) yield table of normative nature presents data given to six yield classes (base age: 25 years) including the most important stand structural and yield features expressing in terms of main stand, removing stand (which can be removed in tending operations) and the total stand. It is based on the currently applied silvicultural practice [3]. The data are given form 5 to years 45 (Table 1). Figure 2.a to 2.f show the height, DBH, volume and stem number indices for main stand as well as the total volume and the mean annual increment of total volume indices in function of age and yield class.

When using the yield table for determining the actual volume per ha (V_{act}) of a stand, a basal area ratio is to be recommended:

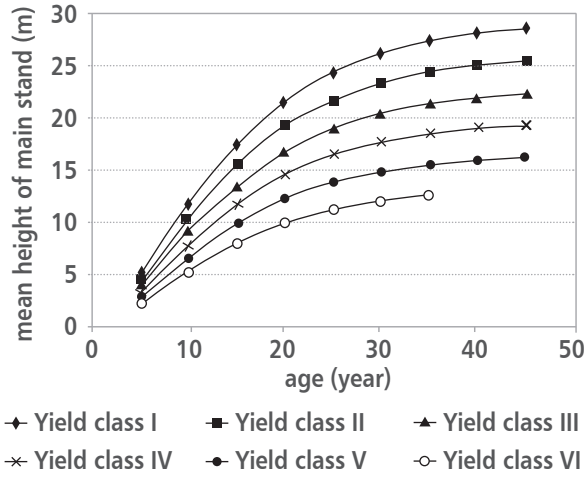
$$V_{act} = V_{tab} \times BA_{act} BA^{-1}_{tab}$$

where:

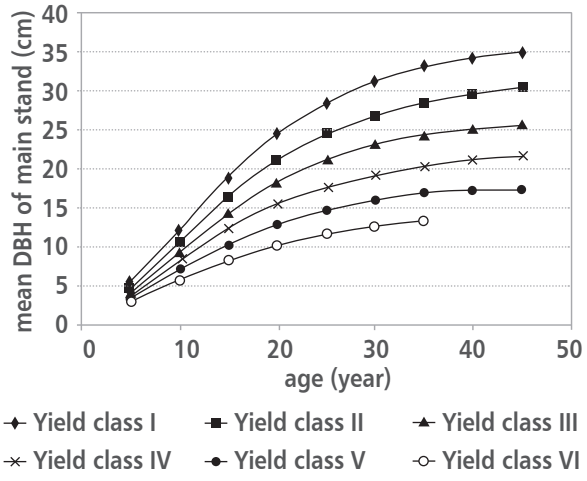
V_{tab} = volume of the stand by yield table according to the age and yield class,

BA_{act} = actual basal area of the stand per ha,

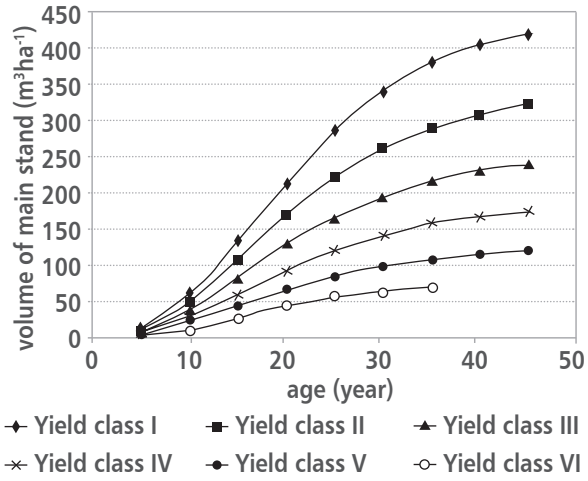
BA_{tab} = basal area by yield table according to the age and yield class of the stand.



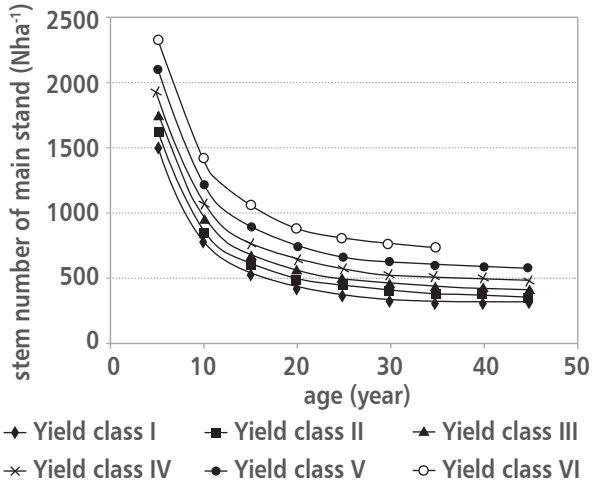
a) Mean height yield class indices for main stand



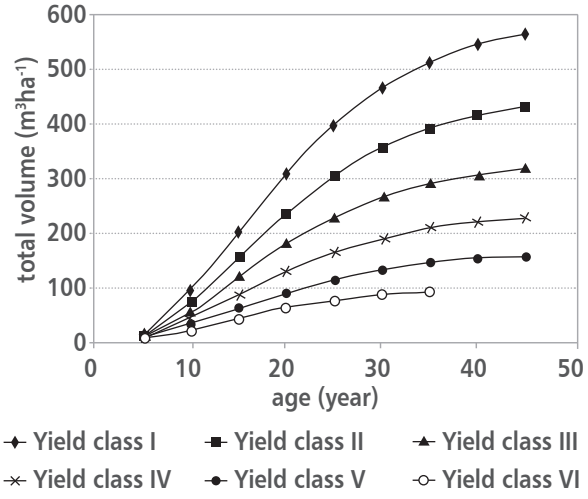
b) Mean DBH yield class indices for main stand



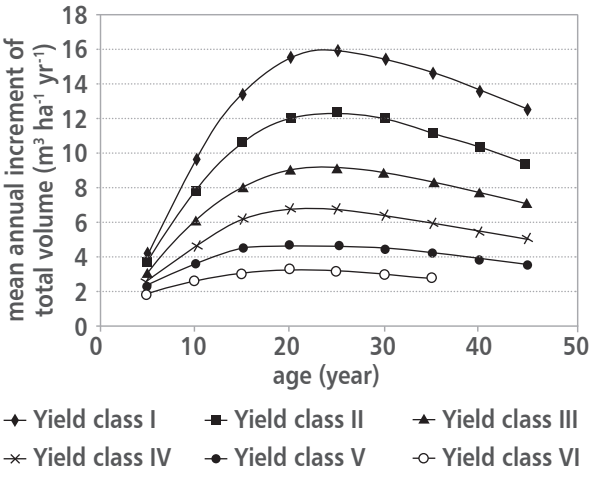
c) Volume yield class indices for main stand



d) Stem number yield class indices for main stand



e) Total volume yield class indices



f) Mean annual increment of total volume yield class indices

FIGURE 2
White poplar stand structure factors in function of age and yield class

DISCUSSION AND CONCLUSIONS

Growth is a biological process, which is defined and measured as the change in volume and other size parameters as a function of age. Yield quantifies the volume (or weight) of the whole stand or of a single tree, which is potentially available at the time of harvesting. In order to obtain a biologically meaningful estimate for growth, the volume should reflect the total, rather than merchantable stand volume, although the latter is required for management inventories.

The published empirical yield table is the first one for white poplar stands in the international literature based on Chapman – Richards function used for yield – dependent height growth model. This type of yield tables supposedly applies to "average" rather than full stocking. In other words, an empirical yield table applies only to the average density levels found on the sample plots used.

Empirical yield tables provide few advantages over full stocking yield tables; the principal idea behind their construction was that the resultant tables should more closely approximate realizable yields under operational forest management than would the values from full stocking yield tables [8]. In spite of this fact the modern growth and yield modelling techniques do not rely on either "average" or full stocking density concepts, but, rather, include density as a dynamic part of the stand-projection system. Such growth and yield models are commonly termed variable-density tables (or equations).

In the last decades, growth models focussed on stand level data have gradually been replaced by stand growth models that predict stem number frequencies and individual-tree growth models [11]. In spite of this fact yield tables will remain very useful tools for forest management and forest inventory in the future.

The published yield table can be widely utilized in the following fields of the Hungarian white poplar management and the relevant forest inventory:

- appraisal of statistical nature of the white poplar stands,
- harvest scheduling of white poplar stands, implementing the volume estimations,
- elaborating or further developing silvicultural (tending operation) models for white poplar stands,
- elaborating and explaining the guidelines of the local tree species policy, and
- national analysis related to the growing of white poplar stands.

To improve the yield models for white poplar stands is to be considered as a continuous task in the future, too.

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TABLE 1
Yield table for white poplar stands

Age of stand	Main (remaining) stand					Removal stand					Total stand					Cumulative volume of intermediate cuttings	Share of intermediate cuttings	Cumulative total volume		
	average		volume	basal area	stem number	average		volume	basal area	stem number	average		volume	basal area	stem number			volume	mean annual increment	current increment
	height	diameter				height	diameter				height	diameter								
	H_m	Dm	V_m	BA_m	N_m	H_m	Dm	V_m	BA_m	N_m	H_m	Dm	V_m	BA_m	N_m					
yr	m	cm	m^3ha^{-1}	m^2ha^{-1}	ha^{-1}	m	cm	m^3ha^{-1}	m^2ha^{-1}	ha^{-1}	m	cm	m^3ha^{-1}	m^2ha^{-1}	ha^{-1}	m^3ha^{-1}	%	m^3ha^{-1}	$m^3ha^{-1}yr^{-1}$	$m^3ha^{-1}yr^{-1}$
Yield Class I																				
5	4.7	5.4	14	3.5	1539	3.3	3.8	7	1.8	1587	3.7	4.7	21	5.3	3126	7	33.6	21	4.1	0.0
10	11.6	12.2	61	9.1	778	8.1	8.5	29	4.4	761	10.8	10.5	90	13.4	1539	36	37.3	97	9.7	15.2
15	17.3	19.0	136	15.1	537	12.1	13.3	30	3.3	241	16.6	17.4	166	18.5	778	66	32.6	203	13.5	21.1
20	21.4	24.5	217	20.4	433	15.0	17.1	26	2.4	104	20.8	23.2	243	22.7	537	92	29.7	309	15.5	21.3
25	24.2	28.5	288	24.3	381	16.9	20.0	19	1.6	52	23.8	27.6	307	25.9	433	111	27.8	398	15.9	17.9
30	26.0	31.3	341	27.1	352	18.2	21.9	14	1.1	29	25.6	30.7	354	28.2	381	125	26.8	465	15.5	13.4
35	27.2	33.2	379	29.0	336	19.0	23.2	9	0.7	16	26.8	32.8	388	29.7	352	134	26.0	513	14.7	9.5
40	28.0	34.3	405	30.3	326	19.6	24.1	6	0.5	10	27.6	34.1	411	30.7	336	140	25.6	545	13.6	6.4
45	28.4	35.2	421	31.0	319	19.9	24.6	5	0.3	7	28.1	35.0	425	31.3	326	144	25.5	565	12.6	4.1
Yield Class II																				
5	4.2	5.0	12	3.2	1654	3.0	3.5	6	1.7	1802	3.2	4.3	18	4.9	3456	6	34.8	18	3.6	0.0
10	10.3	10.9	49	7.9	858	7.2	7.6	22	3.6	796	9.5	9.4	71	11.5	1654	29	36.8	78	7.8	11.9
15	15.4	16.6	107	13.0	599	10.8	11.6	23	2.8	259	14.7	15.3	130	15.8	858	51	32.3	159	10.6	16.2
20	19.1	21.3	169	17.4	487	13.3	14.9	19	2.0	112	18.5	20.3	188	19.3	599	70	29.4	240	12.0	16.2
25	21.6	24.7	222	20.7	430	15.1	17.3	14	1.3	57	21.0	24.0	237	22.0	487	85	27.6	307	12.3	13.5
30	23.2	27.1	262	22.9	398	16.2	19.0	10	0.9	32	22.7	26.6	272	23.8	430	95	26.6	357	11.9	10.0
35	24.3	28.7	290	24.4	379	17.0	20.1	7	0.6	19	23.8	28.3	297	25.0	398	102	26.1	392	11.2	7.0
40	24.9	29.7	309	25.5	368	17.5	20.8	8	0.4	11	24.5	29.5	314	25.8	379	107	25.7	416	10.4	4.7
45	25.4	30.4	322	26.2	362	17.8	21.2	3	0.2	6	24.9	30.2	325	26.4	368	109	25.3	432	9.5	3.2
Yield Class III																				
5	3.7	4.5	10	2.9	1787	2.6	3.2	6	1.6	2070	2.7	3.9	16	4.5	3857	6	26.2	16	3.1	0.0
10	9.1	9.6	39	6.8	954	6.4	6.7	17	2.9	833	8.2	8.3	55	9.8	1787	22	36.5	61	6.1	9.1
15	13.5	14.4	83	11.0	675	9.5	10.1	17	2.2	279	12.8	13.3	99	13.3	954	39	32.1	122	8.1	12.1
20	16.8	18.3	128	14.6	552	11.7	12.8	14	1.6	123	16.1	17.5	142	16.1	675	53	29.3	181	9.1	11.9
25	19.0	21.2	167	17.2	490	13.3	14.8	10	1.1	62	18.3	20.6	177	18.3	552	63	27.5	230	9.2	9.9
30	20.4	23.1	196	19.1	455	14.3	16.2	7	0.7	35	19.8	22.7	204	19.8	490	71	26.5	267	8.9	7.3
35	21.3	24.4	217	20.3	434	14.9	17.1	5	0.5	21	20.8	24.1	222	20.8	455	76	25.9	293	8.4	5.1
40	21.9	25.3	231	21.1	422	15.4	17.3	3	0.3	12	21.4	25.1	234	21.4	434	79	25.5	310	7.7	3.4
45	22.3	25.8	240	21.6	414	15.6	18.1	2	0.2	8	21.8	25.7	242	21.8	422	81	25.4	321	7.1	2.2

Age of stand	Main (remaining) stand					Removal stand					Total stand					Cumulative volume of intermediate cuttings	Share of intermediate cuttings	Cumulative total volume		
	average		volume	basal area	stem number	average		volume	basal area	stem number	average		volume	basal area	stem number			volume	mean annual increment	current increment
	height	diameter				height	diameter				height	diameter								
	H_m	Dm	V_m	BA_m	N_m	H_m	Dm	V_m	BA_m	N_m	H_m	Dm	V_m	BA_m	N_m					
yr	m	cm	m^3ha^{-1}	m^2ha^{-1}	ha^{-1}	m	cm	m^3ha^{-1}	m^2ha^{-1}	ha^{-1}	m	cm	m^3ha^{-1}	m^2ha^{-1}	ha^{-1}	m^3ha^{-1}	%	m^3ha^{-1}	$m^3ha^{-1}yr^{-1}$	$m^3ha^{-1}yr^{-1}$
Yield Class IV																				
5	3.2	4.1	8	2.6	1943	2.2	2.9	5	1.6	2453	2.1	3.5	14	4.1	4396	5	38.2	14	2.7	0.0
10	7.8	8.3	30	5.8	1073	5.5	5.8	12	2.3	870	6.9	7.3	42	8.1	1943	17	36.3	47	4.7	6.7
15	11.7	12.3	62	9.2	771	8.2	8.6	12	1.8	302	10.9	11.4	74	11.0	1073	29	31.9	91	6.1	8.7
20	14.5	15.5	94	12.0	636	10.1	10.9	10	1.2	135	13.7	14.8	104	13.3	771	39	29.1	133	6.7	8.5
25	16.4	17.8	122	14.1	566	11.4	12.5	7	0.9	70	15.7	17.3	129	14.9	636	46	27.5	168	6.7	6.9
30	17.6	19.4	142	15.6	527	12.3	13.6	5	0.6	39	17.0	19.0	147	16.1	566	51	26.5	194	6.5	5.1
35	18.4	20.4	157	16.5	504	12.9	14.3	4	0.4	23	17.8	20.2	160	16.9	527	55	25.9	211	6.0	3.6
40	18.9	21.1	166	17.2	491	13.2	14.8	2	0.2	13	18.3	21.0	169	17.4	504	57	25.5	223	5.6	2.4
45	19.3	21.6	173	17.6	482	13.5	15.1	2	0.2	9	18.6	21.5	174	17.7	491	59	25.3	231	5.1	1.5
Yield Class V																				
5	2.7	3.7	7	2.3	2128	1.9	2.6	5	1.5	2964	1.6	3.1	12	3.8	5092	5	40.6	12	2.3	0.0
10	6.6	7.1	23	4.9	1223	4.6	5.0	8	1.8	905	5.6	6.3	31	6.6	2128	13	36.4	36	3.6	4.8
15	9.8	10.3	45	7.5	894	6.9	7.2	8	1.3	329	9.0	9.6	53	8.8	1223	21	31.9	66	4.4	6.0
20	12.2	12.9	67	9.6	744	8.5	9.0	7	1.0	150	11.4	12.3	73	10.6	894	28	29.2	94	4.7	5.7
25	13.8	14.7	85	11.2	666	9.6	10.3	5	0.6	78	13.0	14.3	90	11.9	744	32	27.6	118	4.7	4.7
30	14.8	15.9	99	12.4	622	10.4	11.1	3	0.4	44	14.1	15.6	102	12.8	666	36	26.6	135	4.5	3.4
35	15.5	16.7	109	13.1	597	10.8	11.7	2	0.3	25	14.8	16.6	111	13.4	622	38	26.0	147	4.2	2.4
40	15.9	17.3	115	13.6	581	11.1	12.1	2	0.2	16	15.2	17.1	116	13.8	597	40	25.7	155	3.9	1.6
45	16.2	17.6	119	13.9	572	11.3	12.3	1	0.1	9	15.5	17.5	120	14.0	581	41	25.4	160	3.6	1.0
Yield Class VI																				
5	2.2	3.3	6	2.0	2352	1.5	2.3	4	1.5	3742	1.1	2.7	10	3.5	8094	4	43.8	10	2.0	0.0
10	5.3	6.0	10	4.0	1418	8.7	4.2	5	1.3	934	4.4	5.3	22	5.2	2352	10	37.1	26	2.6	3.2
15	8.0	8.4	31	5.9	1059	5.6	5.9	5	1.0	359	7.1	7.9	36	6.9	1418	15	32.4	46	3.0	3.9
20	9.9	10.4	45	7.5	892	6.9	7.3	4	0.7	167	9.0	9.9	49	8.2	1059	19	29.6	64	3.2	3.7
25	11.2	11.7	57	8.7	803	7.8	8.2	3	0.5	89	10.3	11.4	60	9.2	892	22	28.0	79	3.1	2.9
30	12.0	12.7	65	9.5	753	8.4	8.9	2	0.3	50	11.2	12.5	67	9.8	803	24	27.0	89	3.0	2.1
35	12.5	13.3	71	10.0	724	8.8	9.3	1	0.2	29	11.8	13.2	72	10.2	753	26	26.4	97	2.8	1.5

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Original scientific paper

Conflicts Between Forestry and Wood-Processing Industry in Bosnia-Herzegovina: Reasons, Actors and Possible Solutions

Bruno Marić

University of Sarajevo,
Faculty of Forestry,
Zagrebačka 20,
71000 Sarajevo
Bosnia-Herzegovina,
bruno.m.maric@gmail.com

Mersudin Avdibegović

University of Sarajevo,
Faculty of Forestry,
Zagrebačka 20,
71000 Sarajevo
Bosnia-Herzegovina

Doni Blagojević

European Forest Institute,
Torikatu 34,
80100 Joensuu
Finland

Dženan Bećirović

University of Sarajevo,
Faculty of Forestry,
Zagrebačka 20,
71000 Sarajevo
Bosnia-Herzegovina

Amila Brajić

University of Sarajevo,
Faculty of Forestry,
Zagrebačka 20,
71000 Sarajevo
Bosnia-Herzegovina

Senka Mutabdžija

University of Sarajevo,
Faculty of Forestry,
Zagrebačka 20,
71000 Sarajevo
Bosnia-Herzegovina

Sabina Delić

University of Sarajevo,
Faculty of Forestry,
Zagrebačka 20,
71000 Sarajevo
Bosnia-Herzegovina

Špela Pezdevšek Malovrh

Biotechnical Faculty,
Department of Forestry
Slovenia

Abstract

Background and purpose: Caused by appearance of new stakeholders and diversification of their interests towards forests, different forest-related conflicts emerged worldwide. As a country with economy in transition and relatively young democracy, Bosnia-Herzegovina might be suitable for understanding the roots, actors and varieties of these conflicts. This paper deals with the most frequent forest-related conflicts, main actors involved as well as undertaken actions in order to manage them in Bosnia-Herzegovina.

Materials and methods: The theoretical framework is based on the Conflict Management Progress Triangle consisting of three dimensions of conflict: substance, process and relations. As particular focus in this paper is given to conflicts between forestry and wood-processing industry, the primary parties in this study were public forestry companies and wood processing companies. For the purpose of this survey a special questionnaire has been designed. The survey population included the most important actors of forest and wood-processing industry as follows: ministries of forestry, nature protection and physical planning at all levels, managers/owners of wood-processing companies, managers of public forest companies and public forest administration, representatives of the most important environmental NGOs and professional associations, managers of protected areas and water management authorities, heads of forest research institutions, economy of chambers and international institutions. In total 136 questionnaires were collected, out of which 68 respondents identified conflicts between forestry and wood-processing industry as the most important ones.

Discussion and conclusions: The results show that the main causes of these conflicts are: differences in demand and supply of wood assortments, way of selling of wood assortments (including quantities and delivery dynamics) as well as wood assortments prices. As the most prominent action among the undertaken ones to manage the conflicts, the respondents underlined adoption of criteria for transparent selling of wood assortments. The results of this paper might be useful for both, public forest companies and wood-processing companies. Timely identification and implementation of possible solutions in order to overcome the most pronounced conflicts would increase competitive advantages for both sides.

Keywords: Forest-related conflicts, forestry, wood-processing industry, conflict management, Bosnia-Herzegovina

INTRODUCTION

Forestry and wood-processing industry are traditionally the most important pillars of B-H economy. Besides, forestry together with agriculture has irreplaceable role for development of rural and remote areas in the country. Unlike other countries with economy in transition, B-H emerged from the war with almost totally destroyed infrastructure and ruined industry. In such circumstances, recovering of the national economy heavily depended on natural resources such as forests, water and minerals. In 1999, only three products (beech wood, aluminium and electrical energy) made 54% of the total export value of the Federation of B-H [1]. On the other hand, some wider aspects such as globalisation and transition as well as new political framework in B-H (political pluralism, democracy, personal freedoms etc.), significantly influence the society demands towards natural resources. This caused appearance of new stakeholders with different and often confronted interests. In the context of joining to European integrations, prevailing global trends for nature protection, seem to be a binding framework for creating forest policy at the national level. Emerging of non-government sector leads to the new directions in forest policy through launching different actions intend to change day-to-day forest management practices. Possible forest resources shortage, induced by numerous initiatives to establish new protected areas, might seriously endanger economic viability of forest companies but also jeopardize employment of rural population. This leads to various cross-sectoral conflicts and disputes between national policies and local management practices. The variety and incompatibility of stakeholders' interests as well as power distribution among them creates the precondition for different types of forest-related conflicts.

Although B-H society unquestionably has many characteristics of post-conflict society, there are few literature sources that offer a systematic overview of conflicts by type, actors involved, conflict roots and intensity, resolving modalities and other important aspects of the issue. An interesting article about political conflicts in post-war B-H points that the intensity of conflicting quality in transitional societies mainly depends on readiness and competence of political actors in resolving or accommodating the conflict situations [2]. Basic social conflicts in B-H with the focus on national, religious, political and economic values are described in some textbooks [3]. Furthermore, a number of public debates and workshops were organized by different organizations in order to discuss different aspects of conflicts prevention [4] and solving [5].

At the regional level initial research about conflicts has been conducted and results presented through several papers [6-10]. The consistent overview of forest conflicts based on appropriate theoretical framework does not exist in B-H. This is not because of non-existence of forest conflicts, on the contrary - conflicts are so diverse and serious to leave far behind the national research capacities. Due to political and historical circumstances, social and policy relevant forestry research was quite undeveloped, comparing to the traditional milieu of forestry research interests (e.g. forest ecology and silviculture, forest protection, utilization etc.). Still, some authors examined the phenomena of forest conflicts in a way or another, during few last years. Some potential conflicts in the context of different approaches in setting forest management goals were discussed in different papers [11, 12]. Another papers related to the national legislation collisions have identified some disputes between foresters and environmental authorities, mainly related to lack of cross-sectoral dialogue and responsibilities in protected areas management [13, 14]. The way in which forest conflicts, particularly those regarding changing demands of the society towards forests might influence strategic and structural changes in forest enterprises is investigated in doctoral thesis defended at the Faculty of Forestry University of Sarajevo [15]. Although the Federal Strategy for Environment Protection [16] includes the chapters related to public participation and conflict management, all practical activities regarding establishing new protected areas are characterised by lack of theoretical framework to understand the nature of conflicts phenomena and thus cannot offer relevant policy recommendations or realistic conflict management solutions.

MATHERIALS AND METHODS

The objective of the study was to identify the most important conflicts between forestry and other sectors. According to De Vaus surveys are characterized by a structured or systematic set of data [17], in order to produce an overview of the conflicts at the country level, a structured questionnaire with few open questions and with cover letter explaining the background and purpose of the study, was designed and distributed to the top and middle level decision makers (survey population) within the all relevant institutions/organisations as follows: ministries of forestry, nature protection and physical planning at all levels, directors of public forest companies and public forest administration, directors of wood-processing enterprises, managers of protected areas and water management authorities, representatives of the most important environmental NGOs and professional association, heads of forest research institutions and representatives of private forest owners associations, representatives of economy of chambers and international institutions.

Before the final sending to the representatives of the institutions, the questionnaire was pre-tested and improved based on the feedback results. The questionnaires were sent either by e-mail or fax, together with the initial information about the project as well as explanation of possible benefits the respondents might have from the results of the study. After the first round of received answers all the respondents who did not react were reminded with a phone call. In total two reminders were sent to all the respondents who did not response. The survey was conducted during the period October-December 2008 in both entities (the Federation of B-H and Republic of Srpska) and the response rate was calculated 64.7% which is appropriate for this kind of method. The data obtained were coded in the Excel sheet and transformed in the SPSS document for further statistical analysis. Statistical analysis was conducted in the SPSS version 15, and included determination of frequencies for survey questions 1-6. Due to the structure of questionnaire survey analysis was compound from three parts. In the general part (which includes analysis of all 136 received questionnaires), the most important conflicts have been identified and basic data from the national survey research were presented. After the identification of the most expressed conflicts, the separate statistical analysis for the most specific type of conflicts has been done, forestry versus wood processing industry and forestry versus nature protection. Out of 136 questionnaires, 68 identified forestry vs. wood processing industry while 30 identified forestry vs. nature protection as the most important conflict.

Each conflict consists of main cause of disagreement, involved stakeholders, time and spatial frame, methods for conflict management, results and consequences of conflicts. According to Walker and Daniels all definitions of conflicts involve central elements of conflict: perceived incompatibility, interests, goals, aspirations, two or more interdependent parties, incentives to cooperate and compete, interaction, communication, bargaining/negotiation and strategy [18]. Conflict becomes more complex when more than two stakeholders are involved. Each stakeholder has specific role in conflict, conflict management and final outcome of conflict. Positive role can be: readiness for cooperation, tolerance, maximal engagement, good communication skills, readiness for negotiation and compromise while from the other side negative role can be expressed in the predisposition for the conflict, unwillingness for cooperation, latency, destructive actions and lack of communication with other stakeholders. By definition from Walker and Daniels three kinds of parties may appear in any conflict situation. Primary parties perceive that their goals are incompatible with another and interact directly with each other in pursuit of their objectives. Secondary parties have a vested interest in or may be affected directly by the conflict and its outcome, but for some reasons (such as inadequate resources, lack of access, perception of inappropriateness) are not directly involved. Secondary parties are potential coalition members, and may become primary parties at some point. Peripheral parties have an interest in the conflict and outcome but are not affected directly.

The process of conflict management starts by identification of conflict, involved stakeholders and doing first steps in the establishing the communication between confronted stakeholders. The Conflict Management Progress Triangle [18] was adopted as conceptual theoretical framework of this research (Figure 1).

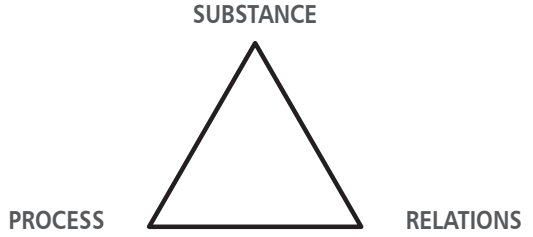

FIGURE 1
Conflict Management Progress Triangle

The conflict management progress triangle can serve as a basic model for understanding the nature of a conflict situation. Its design suggests the importance of determining the substantive, procedural and relationship factors in any conflict. Within these dimensions, other conflict elements such as interdependence, parties, roles, goals, issues and sources of incompatibility can be reviewed. As an assessment is a first step in a process of constructive conflict management, this triangle may be useful as an assessment tool. Under the substance dimension of conflict, one can assume sources of conflicts and what conflicts are about (money, power, emotions, ideologies, values, information etc.). The process dimension is about the way, in which conflict was occurred, aspect of space and time, how it develops (institutionally or personally, democratically or autocratically) and what might be the consequences for policy development. The relations dimension includes actors and relations between them, power distribution, level of trusts, knowledge and skills they possess as well as creating alliances and lobbies. Cultural and policy development perspectives of the conflicts and conflict management are also important [19].

Conflict management approaches also have the same three main attributes. In successful conflict management, the type of management approach

corresponds to the main attributes of conflicts. Substantive conflict (e.g. harvesting versus conservation of rare species) might be solved by substance-oriented approach (e.g. creating multipurpose management plan or by excluding one of these two activities in the area of concern). Procedural-oriented approach can be used to manage procedural conflict (e.g. conflict about non-transparent proclaiming of the Law on protected area can be managed by organizing the public debates in local communities). Following the same logic, relations-oriented approach (e.g. fair compensation policy) can be used to manage stakeholders' relations (e.g. conflict between different stakeholders regarding ownership/using rights.).

RESULTS AND DISCUSSION

In order to find out which are the most important conflicts in Bosnia and Herzegovina respondents were asked in the questionnaire to select the most important conflict among 12 offered conflicts. Conflict between forestry and wood processing industry is identified in the B-H as the most important conflict (50% of respondents) (Figure 2). As the second most important conflict is identified conflict between forestry and nature protection (21% of respondents). On the third place is conflict between forestry and construction sector. There are other conflicts identified such as: forestry and inefficient courts, forestry and grazing, forestry and collection of NWFPs and forestry and mining (0.7%) but not in the significant percentage as previous mentioned.

For the purpose of this paper from now on we will focus on the conflict between forestry and wood processing industry, identified as the most important one.

Main causes of conflict (Figure 3) are as follows: for the conflict between forestry and wood processing industry respondents identified differences in demand and supply of wood assortments (36.7%), quantities,

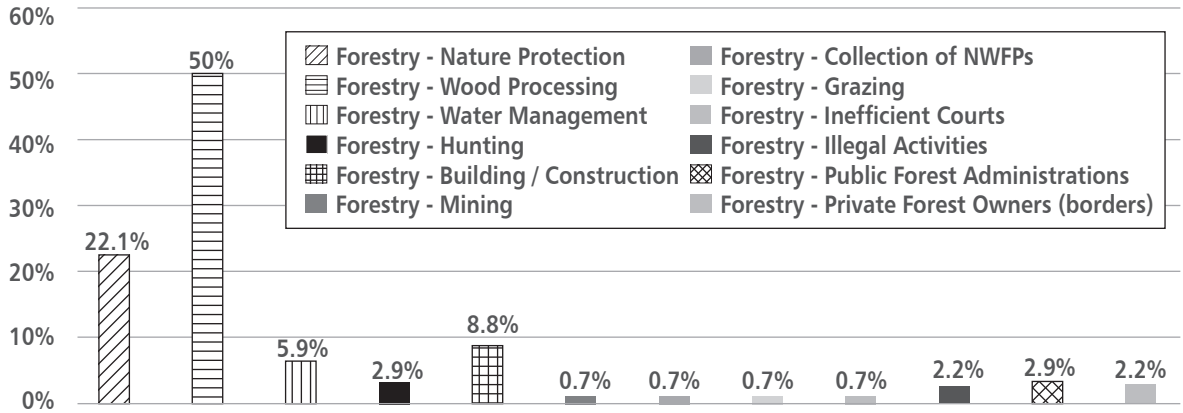

FIGURE 2
The most important forest related conflicts

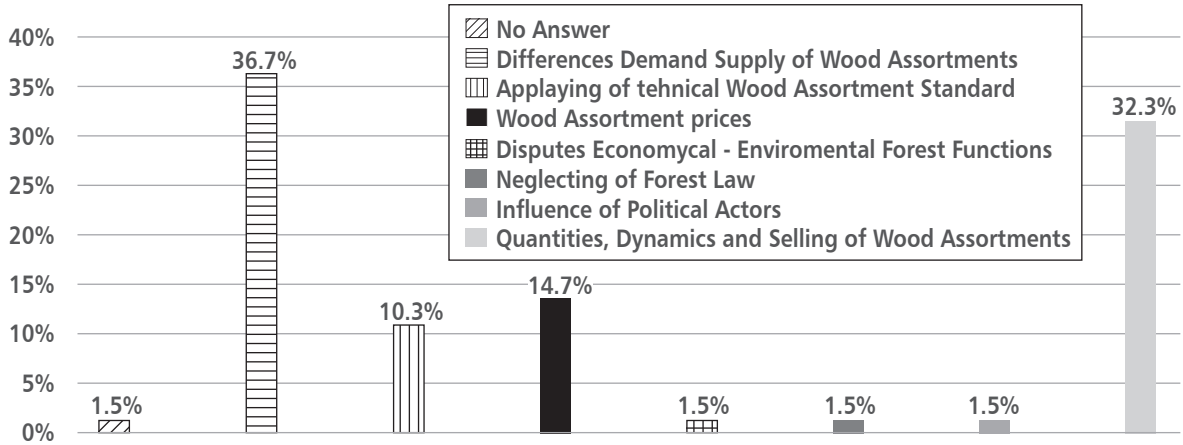

FIGURE 3
Main cause of the conflict between forestry and wood processing industry

dynamics and selling of wood assortments (32.3%) and wood assortments prices (14.7%).

Conflict between forestry and wood processing industry occurs because processing capacities are bigger that production capacities. Each year forest companies can offer amount of wood assortments determined by their management plans. Since demand is bigger than offer there is always price of wood assortments as a limitation factor, followed by different quantities distributed to different wood processing companies.

One can conclude that conflict between forestry and wood processing industry is quite frequent (Figure 4). Majority of the respondent recognized conflict as a frequent and very frequent more than (67%). Wood processing capacities are far bigger than annual cut timber volume, since there are a huge number of wood processing companies which are competing for the raw material conflicts are unavoidable. In fair conditions on market each wood processing company should get quantity of raw material proportional to its size, but very often that is not the case. Larger wood companies occupy larger quantities of raw materials which directly influence on the smaller companies. Although the quantity is very often mentioned as a main cause there is also a problem with quality of wood assortments. Wood processing companies are accusing forest companies for low quality of wood assortments in a way that the raw material second class is sold as a first class material. From the other side forest companies are not satisfied with obtained prices of wood assortments.

Man organizations involved in the conflicts are forest companies (33.3%) and wood processing companies (33.3%) since we are speaking about conflict between forestry and wood processing industry (Figure 5). Beside the primary parties in the conflict it is important to mentioned secondary party which is identified as local politicians/government with (7.8%). Secondary party in this case local politicians have very important role in the conflict in a way that they are lobbying and influencing on the decisions of the management of the forest companies, which are in the most of the cases members of the political parties. Their influence is affecting

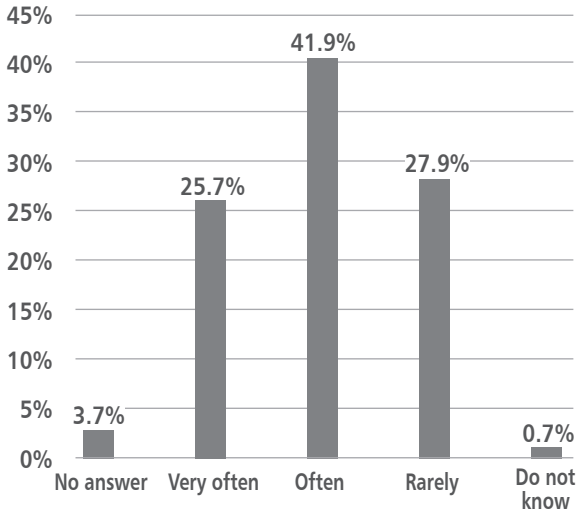

FIGURE 4
Frequency of the conflict

decisions regarding the distribution of the raw material to the wood processing companies. Sometimes the same politicians are owners of the wood processing companies or have other interest to lobby for certain company. Sometimes lobbying activities which are influencing dynamics of delivery, quantity and quality of raw material are done for preserving social peace, in order to provide raw material to the companies which are employing big number of employees.

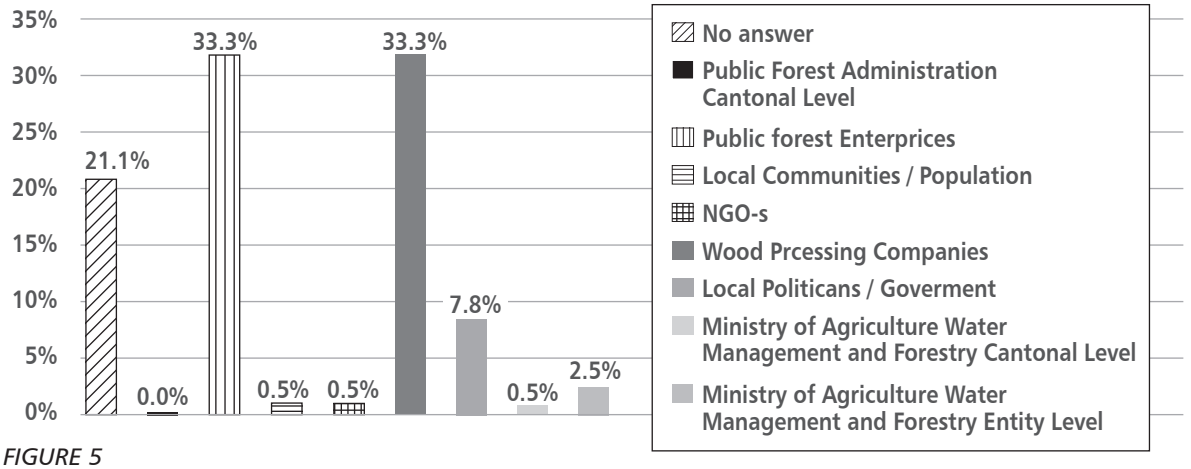

FIGURE 5
Organizations involved in the conflict

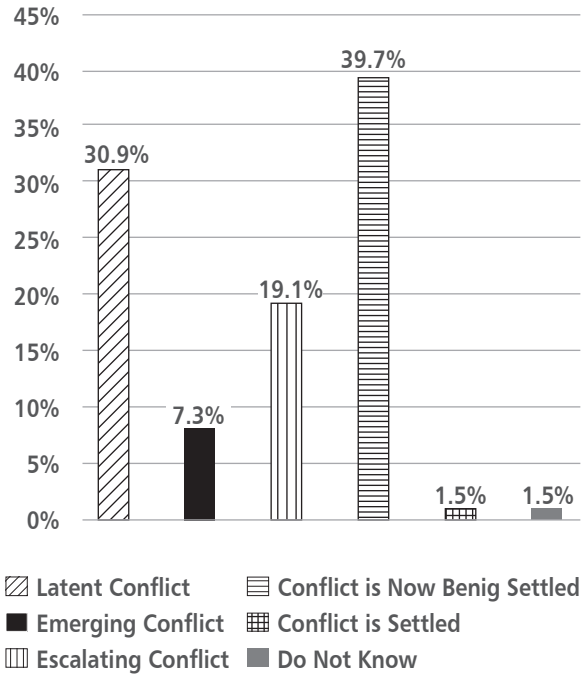

FIGURE 6
Stage of the conflict

Conflict between forestry and wood processing industry is in a stage that conflict is settled (39.7%). Vice versa (30.9%) of respondents thinks that conflict is latent, while (19.3%) of respondents has opinion that conflict is in escalating stage (Figure 6). These different opinions are present because there are different dynamics of selling of raw material. The dynamics of selling raw material depends mostly from the demand and from the season. One can conclude that conflict is always present, in some periods is more emphasised while in some periods is not visible

On the question which actions were done from policy makers in order to manage conflict majority of respondents did not answer (36.7%). Possible reason for that might be that respondents were not able to recognize any of the actions or these actions were not implemented at all. (16.2%) of respondents identified adoption of criteria for transparent selling of wood assortments as the most important one (Figure 7). By the criteria for transparent selling of wood assortments is meant that all wood processing companies are included in the process of distribution of raw material by fulfilling very often criteria such as: decision on registered services, registration on the court, evidence on paid tax, number of employees, processing coefficient and other criteria. Respondents mentioned other actions which were undertaken in the specific cases in their companies (13.2%). By the declarative contribution to the solving the conflict (10.3%) respondents consider that no concrete actions except talk were done. Conflict was managed through the conversation and communication between affected parties.

DISCUSSION AND CONCLUSIONS

This paper identified the most important conflicts in Bosnia-Herzegovina and focus on the conflict between forestry and wood processing industry. Results indicated types of conflicts, primary and secondary par-

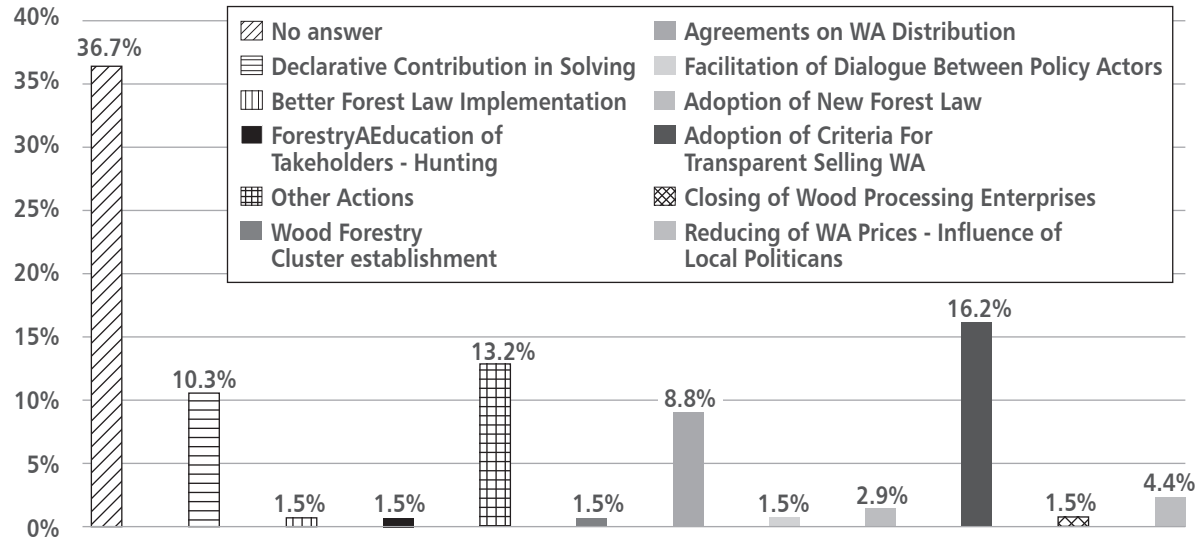

FIGURE 7
Actions done from policy makers in order to manage conflict

ties/actors involved in the conflict, causes of conflicts and what were the actions done from policy makers in order to manage conflict. Primary parties in this conflict were forestry and wood processing companies. Main causes of the conflict were: differences in demand and supply of wood assortments, quantities, dynamics and selling of wood assortments and wood assortments prices. Among the undertaken actions to manage the conflict respondents identified adoption of criteria for transparent selling of wood assortments and declarative contribution through the communication of conflicted parties. This overview of types of conflicts, actors and possible solutions can contribute to the understanding and accepting the existence of the conflicts which were neglected in the period of socialism and contribute to the forest policy development in countries in transition such as B-H. Results in the paper demonstrate that conflicts are present in the forest sector of B-H and as such request more attention and efforts in order to be better managed.

As concerns the conflict as a social phenomenon conflicts are drivers of change, sometimes conflicts are necessary to provoke progress. Conflicts can impact policy development in both, positive and negative way, depending on how they are managed. This impact depends also on conflict intensity and its relevance in given political environment. Sometimes very intensive conflicts (e.g. devastation of huge forest areas) have limited political relevance due to many reasons (forestry is not high ranked in the political agenda, the politicians are involved in conflicts, there is lack of information about the conflicts etc.). As it is already stated, readiness of political actors to change the situation is the essential preconditions for any conflict impact on policy development.

Based on the results of the paper it can be concluded that there are certain changes in policy making attitudes towards the role and significance of the conflict and need for conflict management. It was mentioned that policy makers have significant role in the conflict management. If there is no political will to manage the conflict the process of conflict management will be much slower and will not generate satisfaction of conflicted parties. The interest is the main engine in managing conflict, if political actors estimate that there is no interest in managing conflict, conflicted parties will experience more difficulties in the process of mutual agreement which will be more time consuming.

In the future more attention to this phenomenon should be dedicated, meaning that more deep and detailed research should be done in order to understand the core of the problems and to establish procedures for management of conflicts if possible. More open decision making process including more participants could cause constructive conflict management which will make natural social changes as a main component of democratic societies. The main goal of this paper is to give an overview of existing conflicts in the forest sector and to initiate more intensive research on this issue in the future.

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Development of the Concept and Implementation of National Forest Programs with Reference to Croatia

Marko Lovrić

Croatian Forest Research Institute
Vilka Novaka 50c
42000 Varaždin
Croatia
markol@sumins.hr

Nataša Lovrić

Croatian Forest Research Institute
Vilka Novaka 50c
42000 Varaždin
Croatia

Dijana Vuletić

Croatian Forest Research Institute
Cvjetno naselje 41
10450 Jastrebarsko
Croatia

Ivan Martinić

Faculty of Forestry, University of Zagreb
Svetošimunska 25
10000 Zagreb
Croatia

Abstract

Background and purpose: National forest programs have been promoted by the international forest policy sphere as a preferred form of policy process by which the sustainable forest management should be reached on national level. As such, it has received a lot of attention in the international legislation and has been important part of the forest policy dialogue. This paper examines the national forest programs from the side of its theoretical development, and how it has been transposed from the international sphere onto the national domains.

Materials and methods: Paper examines international legislation refereeing to the national forest programs, and provides an overview of its development. Comparative analysis of national forest program processes in Europe has been made, along with presentation of different national approaches to it. Topic-related scientific literature has been analyzed, with special emphasis on its procedural elements.

Results and conclusions: International legislation shows great coherence regarding the development of the concept of national forest programs. The same coherence is present in the scientific community, but not among the forest policy practitioners, which is reflected by a great variety of developments of national forest programs across Europe. This variety is not as important as are the procedural aspects of the process, which promote mode of governance in line with the new general paradigm of forest planning. The article critically reviews the procedural and outcome elements of national forest programmes, which are then analysed in the context of Croatian perspectives for a formal process of a national forest program.

Keywords: National forest program, participation, power relations

INTRODUCTION

National Forest Program (NFP) does not have a clear-cut definition, for it is a "generic expression for a wide-range of approaches towards forest policy formulation, planning and implementation at the sub-national and national levels" [1]. In a broader understanding it is not even a document, but an iterative process of goal setting, policy planning and implementation within a wide participatory context [2-4]. This is also in line with the position of the Ministerial Conferences on the Protection of Forests in Europe (MCPFE), which defines NFP as a "…participatory, holistic, inter-sectoral and iterative process of policy planning, implementation, monitoring and evaluation at the national and/or sub-national level in order to proceed towards the further improvement of sustainable forest management…" [5]. More narrow definition of it, stemming from the review of NFP documents in Europe, would state that NFP is a mid-term strategic planning document of (usually) ten year validity in which actions set by the long-term Strategy are disseminated through a participatory process into concrete indicators, which have its financial resources, deadlines, implementing agencies and verifications of completion.

The goal of NFP process is country-driven forest sector development, in which the implementation of international forest-related obligations is embedded in. Although the country-leadership is one of the basic principles of NFP, there is a wide range of global initiatives to support its development [4]. In this context NFP is a policy process, and in which there are outputs to each phase of its policy cycle (analysis, formulation, implementation, monitoring and evaluation). The aim

of the paper is to review the scientific literature on the NFP, its national implementation in selected countries and to critically review its procedural and outcome characteristics. These findings are then commented in the context of Croatian perspectives on a formal NFP process.

MATERIAL AND METHODS

International legislation that has references to NFPs has been analyzed on global, pan-European, EU and Croatian level. Analysis shows the development of the concept on different levels and the similarities between the approaches.

The data base of the United Nations Economic Commission for Europe (UNECE) of reports on the pan-European Qualitative indicators for sustainable forest management and national implementation of commitments of the Ministerial Conference on the Protection of Forests in Europe has been analyzed. Elements of the analysis were: relation of the strategic documents to a formal NFP process; inclusion of stakeholders in the policy formulation; balance of economic, social and environmental sides of the sustainability in the policy; uptake of MCPFE instruments. A comparative analysis of development of the NFP processes in 32 European countries has been made. The NFP documents referenced in the UNECE's data base have been analyzed, and a short overview of examples of different development paths of the national NFP processes has been presented, i.e. the cases of Kirgizstan, Finland, Switzerland, Slovenia, Serbia, and the Federation of Bosnia and Herzegovina, Bosnia and Herzegovina.

Scientific literature on NFP has been analyzed, and emphasis has been given on the definition, principles and rationale of the NFP. Critical discussion on the concepts related to procedural elements of the NFP has been made, notably the participation, legitimacy and power. Article ends with a series of recommendation for improving the formulation of NFP documents, with special reference to Croatia.

On the concept of NFP

There is broad common understanding on what the principles of a NFP are, both on the global [1] and on the European [5] level. The presence of these elements in national forest policy is what defines an NFP, and summed up, these principles are [6]:

- *Public participation* is the key to the coordination of participants who seek to use forests for their specific interests.
- *Holistic and intersectoral co-ordination* should ensure that those sectors affecting, and those affected by forest management have an input to the policy process.
- *Decentralization* refers to the co-ordination of actors operating at different levels.
- *Long term, iterative and adaptive planning* takes account of failure to achieve goals, as well as of the changing environment and allows for flexibility and adjustment in NFPs.

Along with the principles of NFP, there is also an understanding on what the goal of NFP is, and it can be defined as "… to promote the conservation and sustainable use of forest resources to meet local, national and global needs, through fostering national and international partnerships to manage, protect and restore forest resources and land, for the benefit of present and future generations" [7].

However, in the international processes referring to NFP (IPF/IFF/UNFF and MCPFE) there is no mention on the reasons why the "principles of NFP" should be used in order to reach vague goals as defined by FAO. This lack of explanation makes NFP and its theoretical foundation a normative and politically defined concept [3]. The abstract and imprecise nature of goals and principles of NFPs is the reason why there is no general understanding on the role and the specific content of NFP among the forest policy practitioners in Serbia [8], Germany and Bulgaria [9], or even across Europe [10]. However, this is not the case with the scientific community. Although it is not possible to draw a causal relation to the NFP, there is nonetheless a direct complementary link [11] to the new general paradigm of forest planning [12], in which policy process is characterized by a bargaining system with participation of all relevant actors that strive for a consensual solution within an iterative, fragmented planning process. These are the characteristics of policy process through which international forest policy sphere is trying to incorporate itself onto the national forest policy sphere. The strong international focus in NFP process may be caused by many reasons. Aside from the reason of increasing the rationality of management of forests resources, other reason could be expansion of influence of international organizations onto the national forest policy domain, which should be viewed in the context of failure to produce so far an internationally binding document on forests. And yet another reason could be the inclusion of interests of environmentalists groups onto the national forest policy formulation [13].

Whatever the underlying causes for NFPs are, it can be stated that theoretically the essence of NFP is about policy change in usually hierarchical governmental organizations, which consists out of redefining roles and responsibilities of institutional actors, changing the relationships between stakeholders and transforming the public forestry sector organizations.

This new mode of governance that NFPs promote can be seen as an informal network of public and private actors which co-operatively strive for the realization of a common benefit – the sustainable forest management [6]. It is important to recognize that by following "principles of NFPs", the policy formulation process in fact produces new knowledge and brings about new capacities, thus incorporating goal setting into the process, and making the process itself as the central component, and not the agreed upon document. On a more theoretical level it can be stated that the NFP process has moved away from the "classical policy planning (implementing public goals through state administration based on rational choice among alternatives [14]) and onto the concepts of communicative action [15] and deliberative democracy [16, 17]. This trend is also present in the forest policy science itself, as the "old" idioms (interest groups, power, public administration) and theories (positivism) have been replaced by new idioms (governance, policy discourses) and theories (neo-institutionalism, discourse theory [18, 19]). In this context the NFP process should not be based on formal bureaucratic organization, but on a collaborative model of organization with coordinative, directive and team elements, whose general structure is constant, but the members and the content of its elements vary over time [20]. The most important prerequisite for such structure are strong participatory mechanisms.

International legislative framework of NFPs

The origins of the NFP process can be found in Tropical Forestry Action Program (TFAP), which was an international response to the growing awareness on deforestation. The TFAP was promoted by the Food and Agriculture Organization of the United Nations (FAO) and the World Resources Institute (WRI), which were supported by the World Bank (WB) and the United Nations Development Program (UNDP). The TFAP were a technocratic planning tool, implemented by external staff, and focused mainly on the forestry sector and its' financial support [26]. This lineage can be seen as in 1999 FAO had defined NFP as an instrument for coordinating external assistance for a implementation of a strategic forestry documents on a national level [8], and seven years later [4] has moved to the broad definition from the beginning of this text. It can be stated that generally TFAP failed, due to the restricted point of view, limited agenda, fading sense of national ownership and donor-dependency [4].

At the United Nations Conference on Environment and Development (UNCED) in 1992, within the Chapter 11 of the Agenda 21, a commitment to the development and implementation of "national forestry action programs and/or plans for the management, conservation and sustainable development of forests" was formulated. Same commitment was further on developed by the Intergovernmental Panel on Forests (IPF), The Intergovernmental Forum on Forests (IFF), the United Nations Forum on Forests (UNFF; all succeeding one another) and the Commission for Sustainable Development's (CSD) first working group for forests. The basic message was that NFPs should be a national framework for the implementation of forest-related commitments stemming out of UNCED [13]. The most comprehensive product of these efforts is the 270 IPF/IFF Proposals for action [27] that were produced between the years 1995 and 2000. The implementation of (150) IPF Proposals for action through NFPs can be clustered into the following groups, which appropriately depict the basic pillars of NFP process [28]:

1. Develop and implement a holistic national forest program which integrates the conservation and sustainable use of forest resources and benefits in a way that is consistent with national, sub-national and local policies and strategies - measures 17a, 70a, 77f and 146e;
2. Develop and implement national policy goals and strategies for addressing deforestation and forest degradation in a participatory manner - measures 29a and 29b;
3. Improve cooperation and coordination systems in support of sustainable forest management within national forest programs which involve all stakeholders including indigenous people, forest owners and local communities in forest decision making - measures 17b, 17f, 17h, 40e and 77f;
4. Develop and apply criteria for effectiveness and adequacy of forest programs - measures 58d and 71b;
5. Monitor and evaluate implementation progress of a national forest program including the use of criteria and indicators for sustainable forest management - measures 17a, 17d and 71b;
6. Develop and promote the concept and practice of partnership, including partnership agreements, between all actors in the implementation of national forest programs - measures 17a, 17i, 40g, 40n, 46e and 77c.

Further call for implementation of the IPF/IFF Proposals for action was made in the Non-legally Binding Instrument on All Types of Forests [29]. The same document also states that NFPs should be integrated with instruments of sustainable development and poverty reduction.

The importance of NFPs is also recognized within Forests Europe (formerly known as the MCPFE) policy process. The first mention of NFP in MCPFE process is in

the Resolution H3 [30], in which the members of the European Community commit themselves to assist countries with economies in transition to develop their NFPs. Five years later in the Resolution L2 [31] the Pan-European (quantitative) Criteria and Indicators for Sustainable Forest Management (C&I for SFM [32]) were endorsed as a reference framework for the formulation of NFPs. The NFP was gaining momentum in the MCPFE process, as it was recognized as the first qualitative indicator in the Improved Pan-European Criteria and indicators for Sustainable Forest Management [33]. At the fourth MCPFE held in 2003 in Vienna NFP was the central topic, as in the Vienna Living Forest Summit Declaration [34] NFP was endorsed as a means for inter-sectoral cooperation. The signatory parties of the Resolution V1 [5] commit themselves to use the MCPFE Approach to NFPs, which is annexed to the Resolution. Other resolutions of the Vienna MCPFE in the same context endorse NFPs as method of implementation of different segments of sustainable forest management (Resolution V3 for social and cultural dimensions of SFM, Resolution V4 for biological diversity and Resolution V5 for implementation of obligations stemming from the UNFCCC). Similar mode of endorsement of NFP was present also in the fifth MCPFE held in Warsaw in 2007, where in the Warsaw Declaration [35] signatory states commit themselves to promotion of NFPs, and in the Resolution W2 [36] commit to coordination of forest and water resources through NFPs and integrated water resources management plans. The strategic importance of NFPs to forestry sector in Pan-European context is evident from the Oslo Ministerial Decision [37] from the sixth MCPFE held in Oslo in 2011, in which the developed and implemented NFPs in all European countries is the first goal of forestry for the year 2020. The EU policy shared the same approach to the NFP as did the MCPFE in the pan-European context, as the EU Forest strategy [38] identified NFPs as a framework through which forest-related international commitments should be implemented. The same statement was made in the EU Forest action plan [39]. The Action plan also states that the development of NFPs should be done through application of the open method of coordination, which is a method based on voluntary actions of the member states of the European Union, and on its soft law (quasi-legal instruments which are not legally binding) mechanisms, such as criteria and indicators, benchmarking, best practices and broad participation.

Participation and legitimacy in NFP process

From the perspective of public administration, there are three rationales why public participation should be included in environmental decision making [21]; it enhances information basis and the scrutiny of environmental matters, it is a part in the well-established international human right legislation, and it constitutes a prerequisite for legitimacy, i.e. public acceptance of decision. Based on Aarhus convention [22] and other legislative acts, the same author gives a series of recommendations for participators decision making within a NFP process, which are presented in Table 1.

Since NFP process should cover wide range of topics through usage of participatory mechanisms, the issue of legitimization of the NFP process arises. This could be solved [23] by making the scope of the process restricted just to its participants, or making the process "Pareto efficient", i.e. to reallocate forest resources in such a way that at least one party is better off, without

TABLE 1
Recommendations for high participation in NFP process (based on [21])

INITIATION PHASE	PROCEDURAL ASPECTS OF THE PROCESS	OUTCOME AND IMPLEMENTATION
Political commitment to implementation of the decision	Early participation	Participation in developing the outcome
Sufficient financial resources	Genuine opportunity to participate	Participation in implementation
Cross-sectoral representation	Access to information	Implementation has taken into account outcome of participation
Independent moderator / facilitator	Standardized rules for participation	Legal review if implementation violates decision
Agreement of sharing information and recognition of a long-term scope	Code of conduct	Transparent implementation and monitoring
Procedures for monitoring and evaluation		

1Type of document – formal NFP process; Process guided by NFP principles; similar process; none of the above,

making anyone worse off. The practice has showed that this issue is usually resolved by broad stakeholder and public participation, which could have similar issues on its own. Participatory mechanisms exercised through NFP process may lack democratic legitimization, since stakeholders enrolled in it are "neither democratically authorized nor accountable to the population" [24]. One way of circumventing this problem would be opening up of the process to the public, but that would cause serious difficulties in the organization of the process, and would probably be met by a resistance of the representatives of stake-holding groups. Such unrestricted public access to the NFP process would also negate representatives, as it would allow some actors to expand their bargaining power simply by delegating additional participants. Learning from the NFP process in Germany, Elasser [24] argues that public acceptance of forest policy goals could by more improved by appropriately altering the partly incorrect public image of forestry, rather than with providing detailed information about specific goals and their background. Additional problem arise if unanimity is used, since the probability of reaching any decision decreases with the increase in the number of participants, thus perpetuating status quo. Pragmatic solution to these issues would be loosening the conditions of unanimity and unrestricted access when the progress in the NFP process is blocked. Other solutions to the veto situation would be [23]:

- *issue decomposition*
  tracing the specific element of the issue that blocked the progress, and then removing it.
- *issue linkage*
  linking the specific element with many other, making the entire package beneficial to all groups.

The same paper also states a series of procedural strategies for circumventing vetoes: concealing the issue behind vague or ambiguous wording; presiding from binding agreement to a more general notice of attention; putting the disagreement into brackets for later treatment and stating both views in the proposal of the document. These are just some of the procedural elements that the national leadership of the NFP process gives governments considerable discretion to change the relations among actors and ideas, thus affecting in a considerable way the policy outcome [25].

Overview of NFP selected process

The organization that is a global leader in endorsing the NFP on a global scale is the FAO and its NFP Facility. The Facility has been established in 2002 with the goal of supporting stakeholder involvement in the forest policy process. Majority of their activities are set in South America, Africa and Southeast Asia. Up to March 2012 they have implemented 749 activities in 70 partner countries, and 19 activities through 4 regional initiatives [40].

The issue on what NFP is has made it difficult to list which countries have it. One viable source for such list on the pan-European scale is the data base of reports on the pan-European Qualitative indicators for sustainable forest management and national implementation of commitments of the Ministerial Conference on the Protection of Forests in Europe, which belongs to the UNECE [41]. From this data base Table 2 was compiled, which provides some insight into the status of NFPs in Europe

Although the basis for this table are national reports of the respective ministries to the UNECE, the data presented in it should not be taken for granted, as the analysis of the documents referenced in the reports show that the criteria upon which they are characterized as a NFP or other types of documents is not clear. Examples issues are the categorizations forest Strategies as formal NFPs in Croatia and Macedonia [42], or German classification of their formal NFP [43] as being a similar to NFP.

Finland can be considered as a pioneer of formal NFP process [44]. Finnish NFP 2010 [45] was formulated in 1999 through broad public participation (38 experts, 59 public forums with 2900 participants that resulted in 190 written opinions), through strong cooperation with six other ministries and both private and public sector, and which was accompanied by formulation of 13 regional forest programs. The general orientation of this NFP is presented in the first sentence of the summary, as the documents covers "… forest utilization as seen from economic, ecological, social and cultural perspective". The same perspective is kept in the strategic aims of the program, as 7 out of 10 are primary economic. The document was revised in 2005 – 2008 period, when Finland's NFP 2015 was made [46]. The new program states the reasons for the revision: "… the impacts of global competition and Russian wood duties as well as climate and energy policy decisions of the EU". The funding needs of the new program also reflect these reasons, as now only minor role is played by the Ministry of Agriculture of Forestry. Accordingly, the general orientation has also changed, and it is now "… to increase welfare from diverse forests", and only half of the strategic aims are primary economic.

From all the NFP documents enlisted in the UNECE data base the Swiss NFP for the 2004-2015 period [47] has gone the farthest as regards to the operationalization of the strategic aims and in the scope of participation. Each objective has its indicator with

TABLE 2
Status of implementation of NFPs in Europe

Country	Type of document[1]	Start of the process / year of the most recent document	Inclusion of stakeholders (out of 10 groups)	Uptake of MCPFE instruments (out of 6)	Country	Type of document[1]	Start of the process / year of the most recent document	Inclusion of stakeholders (out of 10 groups)	Uptake of MCPFE instruments (out of 6)
Albania	guided by	1995/2005	2	5	Macedonia	formal	2006/2006	5	2
Austria	formal	2003/2005	10	6	Republic of Moldova	similar	2001/2001	6	0
Belarus	guided by	2007/2007	2	1	Monte-negro	guided by	2006/2008	6	1
Belgium	Similar	2009/2011	9	4	Norway	guided by	1998/2009	6	2
Bulgaria	guided by	2006/2006	9	3	Poland	similar	1997/2005	2	2
Croatia	formal	2003/2003	6	1	Portugal	guided by	1996/2006	6	1
Cyprus	formal	2000/2002	5	1	Romania	similar	2000/2005	9	1
Czech Republic	formal	2003/2008	6	5	Russian Federation	-	2007/2008	5	1
Denmark	formal	2001/2001	9	1	Slovak Republic	formal	2006/2007	4	4
Finland	formal	1993/2008	9	2	Slovenia	formal	1997/2007	9	3
France	formal	2006/2006	6	4	Spain	similar	1999/2008	6	5
Germany	Similar	2008/2008	-	0	Sweden	similar	2008/2008	9	1
Hungary	formal	2004/2007	4	2	Switzerland	formal	2004/2004	10	3
Italy	Similar	2008/2009	5	4	Turkey	formal	2004/2004	1	3
Latvia	guided by	1998/1998	7	3	United Kingdom	similar	2003/2003	4	2
Lithuania	formal	2002/2007	6	2	Ukraine	guided by	2002/2010	5	3

1 Type of document – formal NFP process; Process guided by NFP principles; similar process; none of the above,

concrete target value, strategic direction, list of measures, implementing agency with list of partners and follow-up measures. The document was developed in 2002 and 2003 by six working groups comprising out of 130 experts, organized according to the Pan-European Criteria and indicators for Sustainable Forest Management. There were also an NFP Forum with 28 decision makers, and a series of 35 seminars and workshops with 3400 participants. The result was an NFP document with balanced ecological, economical and social components.

Perhaps an unique example of a NFP process is the Kyrgyz one, in which a full logical sequence of policy documents and reforms has been made [48]. Entire process was performed with the assistance of the Kyrgyz-Swiss Forestry Support Program (1995-2009), by whose help the entire organizational structure of the sector has changed [49].

The formulation of strategic documents was done through the usage of a "mixed method" of decision making [50], by which the deductive instrumental

("top-down") approach is combined the communicative ("bottom-up") approach. Practically this means the application of through negotiations between all interest groups in all steps of instrumental rationality (identification of problems, formulation of objectives, selection of means and implementation, monitoring and evaluation). Conceptually a sequence of policy reform can be represented by a "double spiral of power re-distribution" [50], in which the first outward spiral is characterized by a policy learning process, and is followed by an inward spiral characterized by policy negotiation.

The National Concept (i.e. a strategy) for Forestry Development was made in 1999, and since it comprised mostly out of short-term provisions, it was revised in 2004. National forest program was made the same year [52] which disseminated the 10 strategic lines in finer detail. The NFP explicitly specifies the need for Integrated Management Plans as a basic tool for its practical implementation at the sub-national level [48], and sets a clear division between control/ regulation responsibilities and economic function that should be privatized. The essence of the ten strategic lines was also kept in the National Action Plan (NAP) [53], which regulated the development of the sector in the period 2006-2010. Both NFP and NAP in Kyrgyzstan have clearly defined implementing agencies, expected results, indicators, resources and time frame.

The organizational changes that were introduced by the NAP led the sector to the increasing of authority of the central administration. However, the implementation of the NAP can be characterized as poor [49]. The strategic documents were not followed by a new law that would support it, and the same situation is with by-laws. In 2011, the state forest implementing agency had staff of 11, and so the field-level forestry enterprises played a key role in the sector. These organizations had too poor funding to improve the status of forest, and very low salaries of its employees stimulated illegal logging [49]. In this case it seems that when the donor-driven "by-the-book type" reforms ended, the strategic determinants of the sector failed to cope with the day-to-day reality of a transition country.

A good example of different type of progression in formal NFP is Slovenia, who's first NFP [54] is in fact a strategy [55] with a strong ecological orientation. The Strategy was accompanied with an Operational Program of forest development 1996-2000, which only provided a financial framework for the goals set in the Strategy. Second NFP process started in 2005, and in 2007, with the help of five thematic workshops and 14 regional forums, Slovenian second NFP was made [56] The document is essentially a list of sector-specific, ecologically oriented broad guidelines with indicators that have no threshold values, and with no financial frame of implementation. Although operational plan with concrete measures and responsible actors was set to supplement the NFP, until now such document was not made.

NFP process of Serbia can be characterized as a process of change. It began in 2003 with FAO's project "Institution development and capacity building for NFP of Serbia" and continued in 2005 with another FAO's project "Forest sector development in Serbia". The most important outcomes of the projects [57] were the Draft National Forest Policy, which was adopted in 2006 as a Strategy, and the fourth draft of the Law on Forests, which didn't came into power so far. At the same time the project of the Norwegian Forestry Group "Program for forest sector of Serbia" focused on more technical aspects of policy change, such as development of cost-effective forest management, development GIS capacities, national forest inventory and forest certification. All of those have strengthened and changed institutional environment of the forest sector in Serbia, and strive to a goal of National forest program in compliance to the procedural requirements of new modes of governance and adherence to the international forest-related commitments. So far such document has not been made.

The NFP process in the Federation of Bosnia is much more focused than in Serbia, in which the outline of the NFP document [58] has been made with balanced aims and list of thematic areas. Strong participation is present in many detailed sub-sectoral progress reports that have operational action plans with indicators, deadlines and implementing agencies; however so far there is no unifying text.

Power relations and procedural design of NFP

Power distribution among participants of the NFP process is an important factor contributing to the influence of stakeholders to the NFP process, and thus to the degree of realization of their interest in the outcome document. Most probably any NFP process will contain uneven distribution of representation of interests, due to the facts that specialized interest groups are more likely to be organized than general interests [59], and that costs and benefits of participation differ among interest groups [23]. One way of managing power misbalance would be designing the participatory and procedural aspects of NFP on a strong foundation in stakeholder analysis that makes the power relations overt; an example of which could be the work of International Institute for Environment and Development [60]. Another issue would be the

principal-agent problem [61], by which the representatives of stakeholder groups may have little bargaining power, and that they may have their self-interest that diverge from the interests of their principals. This problem can be circumvented if the process is composed out of high-ranking representatives that have more discretionary power.

Goals within NFP process may be weakly defined, because powerful users of forests are opposed to further regulation through binding decisions, and so goal setting and inter-sectoral coordination within a NFP process may have just symbolic success in a form of a binding document that will not produce and substantial change. As such, the NFP document can be used by those leading the process as a tool by which they can raise public demand for their specific interests (as opposed to similar strategic documents from other sectors). Based on regional planning experiences from 11 Central European Countries, Krott [62] makes the following recommendations for the formulation of NFP:

- Focus on selected goals in which broad coordination of stakeholders can be achieved, in order to ensure at least some binding potential of the document.
- Make clear to forest users that the NFP process is a tool by which the sector will cope actively with demands and restrictions coming from its surrounding – this will diminish their rejection of additional regulation.
- Combine the NFP formulation with the modernization of the state forest enterprise – with clearly defining the multiple productions of forests (such as recreation, nature protection and non-wood forest products). With this strategy specific state budgets can be formulated, and NFP could help legitimize the demands of the state forest enterprise towards the public funds and the central government – and by doing so, NFP would gain a powerful supporter.
- Mediation – Use NFP as a mediator between all forest users, and so maintains its political influence. Mediation has its problems, since it requires social skills not common to foresters, and that certain interest groups and other parts of state administration might become aware of the power and increase in competence that the mediator role brings, and thus they might challenge it.
- Use NFP as an innovation tool for bringing about new products that are specific to forestry – examples of the stated may be creation of a market for the vast forest-related data contained within the information system of the state forest management company.

Not taking enough account of the power relations among stakeholders may even cause writing of an obituary to the NFP concept itself [60], as the Finnish NFP 2010 with its strong adherence to procedural justice produced symbolic NFP program dominated by neo-corporatist network of key forest policy stakeholders that pushed for enlargement of timber production subsidies [63, 64]. In Germany the NFP process was used by the forestry coalition to stall at that time powerful nature conservation coalition in a long lasting negotiation process, with the goal of perpetuating the status quo. In Bulgaria the NFP process was understood by three different coalitions (state forestry, private forestry and the nature protection) as a tool to transform their policy core beliefs into public policy – and when it became obvious that this could not happen, the process was abandoned [10]. The examples described above show that usage of the deliberative mode of governance (and all of its principles that the scientific literature suggests) does not guarantee outcome justice in a NFP process, and that just as easily due to the determinants of power misbalance mean the consolidation of power of the major stakeholders.

The power relations among national stakeholders are not only determinant of the NFP process. The reliance on externally funded projects in the short run produces an NFP process characterized with strong procedural justice (as in Kyrgyz and Serbian case), but in the long run halts the process when the funding ends; as in Serbia it is unclear whether a document more substantive than the Strategy will be made, and the implementation of the strategic documents in Kyrgyzstan is under question.

The usage of NFP as a mechanism for implementation of international legislation is evident in all reviewed European examples. However the uptake of MCPFE instruments (most notably C&I for SFM) is not pronounced. Although the C&I for SFM are extensively used in the mostly technical reporting on forests [65, 66], from the data base of the UNECE of reports on the pan-European Qualitative indicators for SFM and national implementation of commitments of the MCPFE it is evident that they are not widely recognized as a platform upon which national forestry processes are built. This situation is currently being researched within the "CI-SFM" (Implementing Criteria and Indicators for Sustainable Forest Management in Europe) project led by the EFICENT-OEF office of the European forest institute [67], The qualitative C&I for SFM are recognized in the international forest policy domain, as they are one of the platforms for the negotiations on a legally binding agreement of forests in Europe.

Perspectives of NFP development in Croatia

Strategic planning of the forestry sector is defined by the National Forest Policy and Strategy [68], which categorizes its activities into three time-categories: short-term (2003-2006), mid-term (2006-2008) and long-term (2008-). The activities are defined with respect to the strategic documents of the nature protection sector and international commitments, disseminated into the following topics: Management of forest ecosystems; Forest administration and legislation; Non-wood forest products; Forest based industry; Environment and physical planning; Education, research and international cooperation; Public relations. Assessment of the current situation transparently points to different issues, such as overlapping of different parts of state administration, restructuring of the Croatian Forests Ltd. (the state forest management company), management problems of private forests, under-managed non-wood forest products and the status of the wood-processing industry. However, unlike the realistic depiction of the status-quo, the strategic activities have been defined in an over-ambitious manner, and thus mostly have not been implemented. Although there is no explicit mention of NFP in the Strategy, it is defined as a principle instrument of the national forest policy in the Law on forests [69]. Croatia so far does not have an NFP. According to intermediary assessment of the Strategy [70]. 49% of the short-term activities and 33% of mid-term and long-term activities have been implemented. Due to the changes that have had happened from the defining of the Strategy [71] and its partial implementation, there is a need for a process in which new goals for the forestry sector are to be set.

Within the conceptual framework of Advocacy Coalition Framework [72], the NFP process in Croatia would have to encompass conflicts between different core beliefs and/or policy core beliefs of different coalitions (namely coalitions of forestry and nature protection) that would be impervious to policy oriented learning. The reduction of conflict among coalitions by a national "policy broker" (mediators of policy process who channel information among stakeholders and directly influence the output, do not have strong policy beliefs or abandon their preferences; [73]) is also not a dominant strategy, since scientific and state administration organizations can also be seen as a parts of the advocacy coalitions. A possible strategy would be mediation through an international policy broker, which is a viable option – especially since the NFPs are a potential subsidy target of the EU [13]. The assistance of external donors could also facilitate the harmonization of the NFP with respective international legislation both in its outcomes and in the process itself (i.e. usage of qualitative C&I for SFM as a policy platform). However, overly relying on external factors may impede one of the basic principles of NFP – country leadership, and thus lower the implementation of NFP on symbolic level once the funding ends.

Another momentum that could influence the NFP process are the external perturbations that may weaken the cohesion of the forestry coalitions, as parts of it (such as representatives of private forests, parts of the scientific community and private consulting companies) may modify their policy beliefs in order to reduce the uncertainty caused by the possible reorganization of the state forest management company – Croatian Forests Ltd., or by the further diminishing of the "green tax" (OKFŠ). Another momentum may be the strengthening of the nature protection sector, notably the State institute on nature protection [74] which may through the upcoming implementation of the EU nature protection network – Natura 2000 may have significant impact on the NFP and the forestry sector in general. Further perturbations may come in raising the importance of economic viability of forests due to the general stagnating economic situation in Croatia, which would then ease the access of some members of the forestry coalition to the central government. The national economic situation together with the upcoming accession to EU may raise the importance of the elements outside of the policy subsystem to a level in which the power relations and conflicts [71] may not play the leading role (as in the case of second Finnish NFP).

As stipulated previously, making the conflicts overt and recognizing the power relations among stakeholders is a prerequisite for a NFP which is not just symbolically accepted; otherwise these factors will impede its implementation. And as the theory behind NFP suggest, we should step out the frame of classical, instrumental rationality (practical solution gained through participatory formulation and participation) onto the communicative rationality, in which there is a continuous exchange between stakeholders that leads to change and adaptation of institutional arrangements. In this light the lack of ratification or the implementation of NFPs may not be considered negatively, for it is the process itself that is most important, as is represents the true test of "failure" or "success". The time for evaluation of the current strategic forestry goals in Croatia has clearly come, and for its policy subsystem to enter an inward spiral of negotiations that would result in a formal NFP. And regardless on the specifics of the outcome document, such process is needed as it would bring about institutional arrangements fitting to the current situation.

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Professional paper

Does "FOPER" Has Its Own Forest?

Miroslav Benko

Croatian Forest Research Institute
Vilka Novaka 50c,
42000 Varaždin
Croatia

Marta Curman

FOPER Master student

Saša Danon

Croatian Forest Research Institute
Regional office for SEE Europe (EFISEE)
Vilka Novaka 50c
42000 Varaždin
Croatia

Abstract

Background and purpose: Nowadays, when the environmental protection is increasingly gaining in importance, initiation such as conversion of productive forest with primary economic functions into forests with special purpose should be positively welcomed. FOPER forest near Varaždin is an example of this kind of conversion. FOPER Forest is one of the outcomes of FOPER Project which was established on the area of South East Europe. FOPER Forest is located on the area of 3.60 ha of the Management Unit "Zelendvor". On one half of that area Research forest was planted, while on the other half Memorial Park will be planted in spring 2013. Overall aims of FOPER Forest is to acquire habits of people who are living in urban areas to visit green areas; to raise their environmental awareness and to strengthen cooperation in education and research; but even more important is strengthening cooperation and friendship in South East Europe (SEE). Specific aim of FOPER Forest is visitors' education about vegetation of FOPER Project countries in Memorial park and conducting researches in Research part.

Material and methods: Two main methods were used to gather the material on FOPER Project and on FOPER Forest: (I) published literature was reviewed, (II) the Internet and relevant web sites provided access to other information.

Discussion and conclusion: Good promotions of FOPER Forest can attract potential tourists and visitors and raise not only their environmental awareness, but also their awareness of importance of forestry as profession. They could see that forestry is not narrow profession which deals only with management of forests, but a complex scientific profession, which deals with variety of different fields. FOPER Forest is the great example of the overall guiding principle of FOPER Project which is „learning by doing".

Keywords: FOPER Forest, conversion, forest with special purpose, FOPER Project, Memorial part, Research part

INTRODUCTION

In 2004 European Forest Institute (EFI) established a project called Forest Policy and Economics Education and Research (FOPER) on the area of South East Europe, whose research results may contribute to improved legislation, policy, management, and relationships amongst the forestry sector [1, 2]. It is a project which aimed at strengthening the capacity of education, training and research [2, 3], but those were not the only outcomes of this project. In this project hundreds of people from different countries were involved, who developed, during their work on the same goal, cooperation and new friendships for life. In the name of all these great appearances which are result of FOPER, the idea of FOPER Forest spontaneously arose. In the literature we didn't find anything similar and for now FOPER forest is a unique project. FOPER Forest will be a mixture of education, research and pleasure. On one side of FOPER Forest will be Research part which will symbolize primary goals of FOPER and on which researches will be conducted. On the second part of FOPER Forest will be Memorial part (park), which will with its horticultural beautification symbolize cooperation and the friendships, which has arisen during last 8 years among the people from different countries which were involved in FOPER Project. Organized planting of trees for research part already caused a public and media interest.

MATERIALS AND METHODS

Two main methods were used to gather the material on FOPER Project and on FOPER Forest:

1) Published literature was reviewed,
2) The Internet and relevant web sites provided access to needed information.

DESCRIPTION OF FOPER FOREST

FOPER Forest is established near Varaždin, baroque town in north-west Croatia, in which was a base for faculty researchers and students to meet, study, write and hold seminars. Location of FOPER Forest is in Zelendvor which is located in a spacious Drava valley, in Petrijanec, only 15 km west of Varaždin. The area on which FOPER Forest is established is area which belongs to „Hrvatske šume "Ltd., public enterprise for forest and woodland management in the Republic of Croatia, which is the main source of funds for the whole project. In order to establish FOPER Forest, „Hrvatske šume "Ltd. converted part of their production forests into a forests with special purpose. They also made a Management Program which will be the basis for outstanding audit of Management Plan of management unit "Zelendvor". Location of FOPER Forest is on a part of the management unit „Zelendvor", with total area of 336.89 ha, of which 312.93

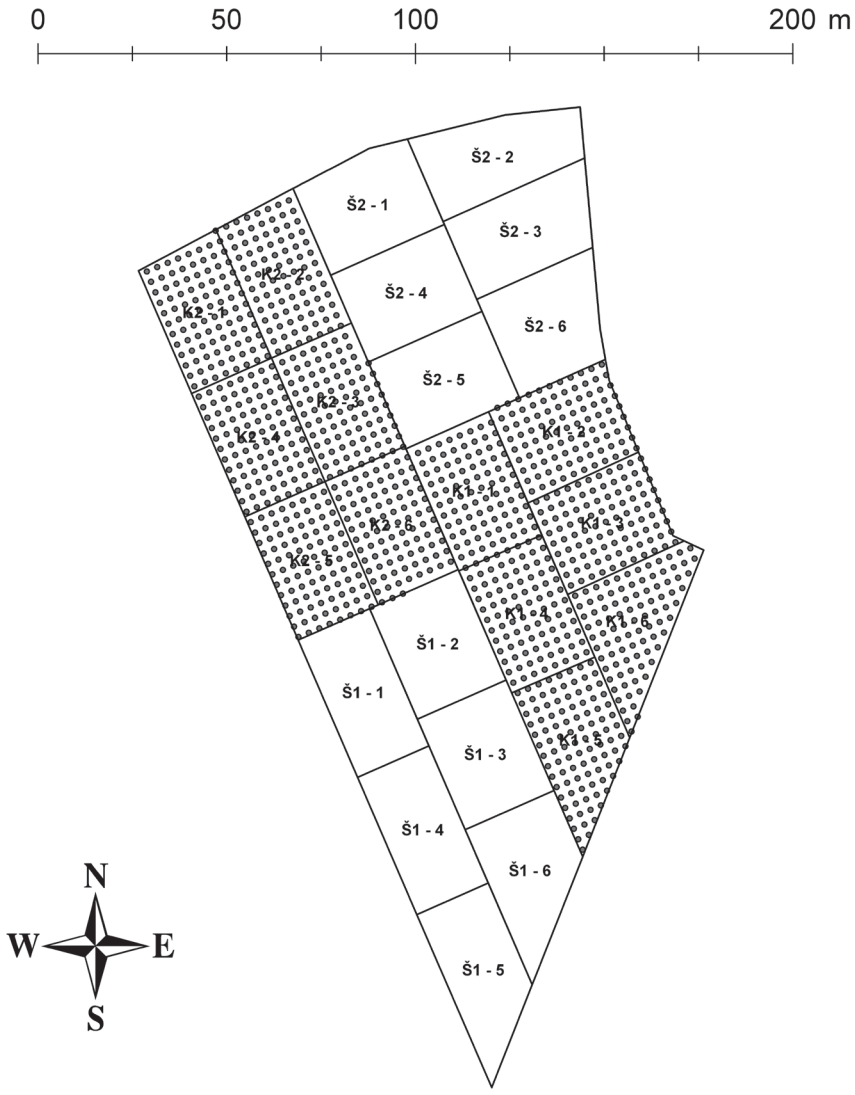

FIGURE 1
Floor plan of Research part

ha is covered with forest land. FOPER Forest will be located on area of 3.60 hectares and has altitude of 187 meters with flat terrain exposition and distric cambisol type of soil [4].

FOPER Forest will be fenced along its entire length in order to protect it from wild game and it is divided in two different parts; Research part and Memorial part (park), with two different purposes.

1. Research Part

Research Part, as one part of FOPER Forest, is located on management unit Zelendvor on parts of compartments 13c and 13d on the area of approximately 2.0 ha of total 3.60 ha. It is established on the previous black locust (*Robinia pseudoacacia* L.) stand. New stand is biologically reproduced according to the principles of Forest Stewardship Council (FSC) standards with native tree species, since all Croatian state owned forests are FSC certified. If protection from pests or other diseases will be needed, environmentally friendly non-chemical methods will be used, so usage of chemical pesticides will tried to be avoided.

In Research part different kinds of monitoring and economical and ecological researches are predicted. Expected results of Research part are: testing a new technology, analyzing profitability of the new technology, visitors’ education and collecting soil, hydrological and climate data of the area. All the collected data will be stored in database specially made for this purpose.

On that part of FOPER Forest are planted 3412 seedlings of penduculate (*Quercus robur* L.) and sessile (*Quercus petraea* Liebl.) oaks, in approximately same share. The field trial was set in random four blocks design in three repetitions (Figure 1). Of total 3412 seedlings, 1107 were planted in tubes with spacing 3×3 m and 2305 were planted without the tubes, with spacing 2×2 m. Every planted tree has its own number and until now data on their height and powdery mildew attack assessment were taken. Timeline (Figure 2) shows the detail plan on measurements in period from 2012 till 2057. The aim is to compare rate of growth using two different planting methods, with and without tubes and to compare which one of those two planting methods is more profitable, in regard with number of planted trees and costs of tendering. In this part of FOPER Forest are two soil pits, due to the variability of soils on that area, and it is taken a soil auger sample.

Other instruments which will be implemented in order to collect data are lysimeters, meteorological weather station, piezometer and hunters’ watchtower. They will be located beside a path which makes a border between Research and Memorial part, on which billboards with description of instruments will be situated. In order to get hydrological data, periodically taken samples from lysimeters will be analyzed in laboratories of Croatian Forest Research Institute. Solar powered automatic weather station will measure temperature of air (on the ground and on 2 m) and soil (in the root zone), relative humidity and the amount of liquid precipitation with pluviometer. It contains software which directly transfers all the data to the Research Center for Urban and Private Forests in Varaždin, which is a department of Croatian Forest Institute. Due to the diversity of terrain and variability of groundwater piezometer will be installed. Hunters’ watchtower will be situated to monitor the development of treetops.

2. Memorial Part (Park)

Memorial Part (Park), as second part of FOPER Forest, will be located in management unit Zelendvor on some parts of a compartments 13 d and 13c with area of approximately 1.6 ha of total 3.60 ha. Memorial part of FOPER Forest is predicted for planting trees and shrubs but overall aim of Memorial part is to ensure place for citizen to visit it in their free time and as

	YEARS	2012	2013	2014	2015	2016	2017	2022	2027	2037	2047	2057
AGE OF TREES		3	4	5	6	7	8	13	18	28	38	48
MEASURMENT												
h	height	X	X	X	X	X	X	X	X	X	X	X
ds	stump dsh		X	X	X	X	X					
d	breast dbh						X	X	X	X	X	X
P	powdery mildew	X	X	X	X	X	X					

FIGURE 2
Timeline on trees’ measurement in the period from 2012. till 2057.

a place for education of pupils and students. Expected results of Memorial Part-Park are: raising visitors' (tourists') ecological awareness, landscape beautification, increasing the number of visitors (tourists) and improvement of cooperation between Finland and South East Europe.

Planting of Memorial part (Park) is predicted on spring 2013 after the terrain will be prepared. Terrain preparation includes removing of Black Locust' roots on autumn 2012.

Regarding conceptual design (Figure 3), the park is divided into cells which will link thematic units with associated flora.

Cells will be perpendicular to the main alley, each separated by paths or roads. Trails in the park would have to retain the naturalness by mowing. In the park trees and shrubs that occur in the lowland and mountain Croatia will be planted, as well as trees and shrubs from partner countries. Planting trees and shrubs will be performed in a way that they simulate the natural composition of plant communities, with aspiration that the rare species will be equally represented as the main species.

Groups of trees and shrubs will be crisscrossed with the meadows. Next to the species of trees and shrubs the nametags with their name will be set, while billboards with their description will be close to the paths.

Total 122 of trees will be planted in the park at intervals of about 4x5 m (depending on type), and 148 shrubs should fill spaces between the trees. It is desirable that trees and shrubs will be plant in groups and individually. The complete list of names and numbers of tree and shrub species are in table (Table 1).

Aim of the project

Beside economic functions to provide us with wood and wood products, forests have social and ecological functions. As society becomes increasingly concerned about the negative impacts of climate change, loss of biodiversity and declining supplies of water; those functions are increasingly gaining in importance. Except raising ecological awareness of individuals, it is very important to create and implement proper politics which will try to prevent those negative impacts. FOPER Forest is a good example in which one part of economical forest will be converted into park and research forest. It has also a great value, due to the vicinity of Educational Path, which with one part passes along northern and northeastern edge of FOPER Forest. The aim of Educational Path is education of primary school pupils about flora and fauna of the immediate environment of their homes. That is going

TABLE 1
List of names and numbers of tree and shrub species

Trees		Shrubs	
Name	Number	Name	Number
Abies alba Mill.	6	*Cornus mas* L.	14
Acer pseudoplatanus L.	2	*Cornus sanginuea* L.	19
Acer platanoides L.	20	*Corylus avellana* L.	3
Alnus glutinosa L.	4	*Crataegus monogyna* L.	3
Betula pendula L.	4	*Crataegus oxyacantha* L.	13
Carpinus betulus L.	5	*Euonymus europaea* L.	4
Fagus sylvatica L.	4	*Genista tinctoria* L.	8
Fraxinus angustifolia L.	3	*Ligustrum vulgare* L.	8
Fraxinus ornus L.	3	*Prunus spinosa* L.	16
Juglans nigra L.	3	*Rosa canina* L.	12
Picea abies L.	5	*Rubus idaeus* L.	3
Picea omorika Pančić	9	*Ruscus aculeatus* L.	8
Pinus nigra Arnold	7	*Ruscus hypoglossum* L.	2
Populus alba L.	3	*Salix caprea* L.	3
Populus nigra L.	2	*Sambucus nigra* L.	6
Prunus avium L.	5	*Staphilea pinnata* L.	11
Pseudotsuga menziesii Franco	5	*Taxus baccata* L.	5
Quercus cerris L.	4	*Viburnum opulus* L.	6
Quercus petrea Liebl.	5	*Vinca minor* L.	4
Quercus robur L.	7		
Salix alba L.	3		
Sorbus aucuparia L.	3		
Sorbus torminalis Crantz	4		
Tilia tomentosa Moench	3		
Ulmus laevis Pall.	3		
TOTAL	122		148

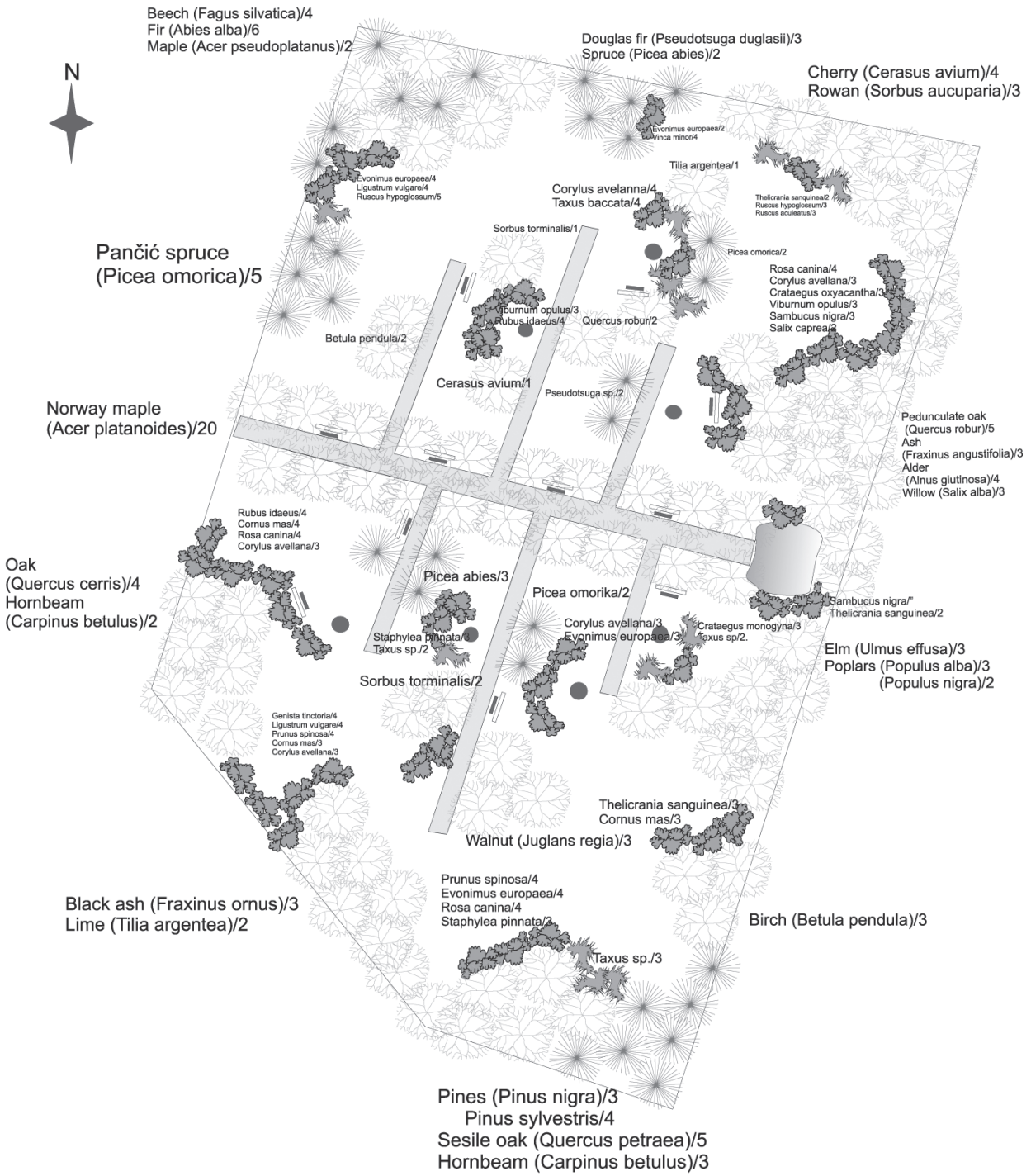

FIGURE 3
Horticultural floor plan of Memorial Park

to be great supplement to FOPER Forest, due to the existence of information about local wild game, which on one side enriches biodiversity of that area, but on the other represents a possible threat to seedlings of FOPER Forest, because it is not fenced yet.

Overall aims of FOPER Forest is to acquire habits of people who are living in urban areas to visit green areas (park forest) during their free time, and to raise their environmental awareness of the social functions of forests, and strengthening cooperation in education and research, but more important is strengthening cooperation and friendship in South East Europe (SEE). Here lies the value of this project due to the conflicts and political tenses in nearly past in SEE region.

Specific aim of FOPER Forest is visitors' education about vegetation of FOPER Project countries in Memorial park and conducting of research in Research part.

DISCUSSION AND CONCLUSION

The fact that organized planting of trees for Research part already caused a public and media interest, it can be assumed that this is a good basis for achieving overall aims of FOPER Forest. Good promotions like that can attract potential tourists and visitors and raise not only their environmental awareness, but also their awareness of importance of forestry as profession. By visiting FOPER Forest they could see that forestry is not only narrow profession which deals only with management of forests, but a complex scientific profession, which is dealing with variety of different fields.

FOPER Forest is not only made for beautification of the area and as a memorial part for FOPER Project, which mostly aims Memorial part; it is also made to get exact calculations on which planting method is more profitable, which partly aims Research part. Century long future researches conducting, which impose Research part, in a way guaranty a future cooperation and friendships not only in Croatia, but also in South East Europe if FOPER Project will be continued in future.

FOPER Forest is the great example of the overall guiding principle of FOPER Project which is „learning by doing".

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