ORIGINAL SCIENTIFIC PAPER

Pan-European Criteria for Sustainable Forest Management - Attitudes of Forestry Professionals in the Federation of Bosnia and Herzegovina

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ABSTRACT

Climate change is recognized as a global threat that negatively impacts biodiversity and forest resources. The use of existing indicators for sustainable forest management (SFM) related to biodiversity and climate change, as well as the development of new indicators, will help assess how forest management practices impact biodiversity enhancement and climate change mitigation. A Pan-European set of criteria and indicators has been developed as a policy instrument for monitoring, evaluating, and reporting on the progress in implementing SFM. In Bosnia and Herzegovina and Western Balkans in general, the Pan-European set of criteria and indicators is an insufficiently researched topic and there is a lack of scientific research conducted regarding their development and implementation. Through the analysis of the current situation in forestry of the Federation of Bosnia and Herzegovina (FBiH), regarding the compliance and importance of the Pan-European criteria for SFM, this paper aims to explain how the international process of development and application of the Pan-European criteria for SFM can contribute to the improvement of the situation in forestry and the creation of a consistent forest policy in FBiH. The survey among forestry professionals (n=360), from the public forest administration and public forest companies in FBiH, included the sets of questions related to socio-demographic characteristics, assessment of compliance and importance of six criteria of SFM. Research results revealed that forestry professionals are mainly males, on average 41 years old, with 13 years of working experience. The majority of forestry professionals in FBiH are not familiar with Pan-European criteria for SFM, and have a low level of their understanding. On average, forestry professionals indicated that the Pan-European criteria for SFM were of high importance, while compliance with current forest management activities were rated lower on average. The large differences between responses regarding the average rating of compliance and importance of the Pan-European criteria for SFM indicate their low level of implementation in FBiH forest management activities. Accordingly, the results indicate that there is a need to organize educational lifelong learning programs in FBiH forestry sector, involving forestry professionals and other interested parties, to generate knowledge related to the Pan-European criteria for SFM and the concept of SFM in general.

Keywords: Federation of Bosnia and Herzegovina; sustainable forest management; sustainable forest management criteria and indicators; forestry professionals; compliance; importance

INTRODUCTION

Nowadays, the concept of sustainability is being integrated into forestry activities. Due to the current socio-economic realities, the concept of sustainable management of forest resources is recognised, among other things, as a process of meeting the present needs of society through the sustainable use of forest resources, together with the continuous improvement of forest conditions, which should also meet the needs of future generations (Sample and Sedjo 1996). It is important to note that people are at the centre of the concept of sustainable forest resource management, with the aim of meeting the various needs of present and future generations (FAO 2022). Various sectoral

policies (climate policy, energy policy, nature conservation policy, etc.) place complex and changing demands on forest resources at the global level, while forest science tries to find solutions that satisfy the interests of various forest-related stakeholders by applying the concept of sustainable participatory management and a multifunctional approach. Following the United Nations Conference on Environment and Development (Rio de Janeiro 1992), international processes and initiatives were launched to formulate criteria and indicators for sustainable forest management (SFM). The criteria and indicators are intended to serve as a forest policy instrument for monitoring, evaluating and reporting on the application and progress of the concept of SFM at global, regional and national levels (Barbati et al. 2013, EFI 2013). In Europe, the Ministerial Conference on the Protection of Forests (formerly MCPFE, now Forest Europe) led the way in defining a set of criteria and indicators for SFM and applying them in practise. The criteria and indicators for SFM have been further developed and adapted over time, while their application has led to the production of national reports on SFM, summarised by Forest Europe in the State of European Forests Report (Forest Europe 2020). Further development of SFM criteria and indicators is foreseen in the areas of ecosystem health, biodiversity and climate change, so that they can become a more detailed screening tool for assessing SFM (European Commission 2021).

With regard to the social, ecological and economic dimensions of forestry, the concept of SFM has historically evolved and become an indispensable paradigm of modern forestry (Floyd 2002). However, in order to assess progress in achieving SFM, it has been necessary to define and develop criteria and indicators for SFM (Wijewardana 2008, Pülzl and Rametsteiner 2009, Rametsteiner et al. 2011). The Pan-European set of criteria and indicators has been researched through several international projects (EFI 2013, FAO 2016, UNECE 2017). In the last few decades, the criteria and indicators of SFM have been more intensively researched, whether it is the implementation of Pan-European criteria and indicators of SFM at the international (Baycheva-Merger and Wolfslehner 2016), regional, national or subnational level (Duinker 2001, Hickey and Innes 2005, Santopuoli et al. 2016, Linser et al. 2018a, 2018b, Linser and Wolfslehner 2022).

When it comes to the Western Balkans region and Bosnia and Herzegovina (BiH), the Pan-European criteria and indicators for SFM are an insufficiently researched topic and there is no significant scientific research on their implementation in forestry. Some authors studied the contribution of SFM based on scientific postulates of sustainable development in BiH (Avdibegović et al. 2022). One of the few papers published in the Western Balkans region that addressed the issue of SFM criteria and indicators focused on assessing progress in SFM in Croatia through the use of quantitative, improved Pan-European criteria and indicators (Lovrić et al. 2010). In BiH, an overview of the set of generic Pan-European criteria and indicators from 2003 was published (Lojo 2016). In addition, authors addressed the possibilities of applying FSC principles and criteria as external standards in the certification process (Avdibegović 2001, 2002, 2004) and examined the set of principles of the concept of "forest governance" in FBiH forestry (Mutabdžija 2012, Avdibegović et al. 2014a, 2017), as well as the

analysis of corrective actions in obtaining and maintaining the FSC certificate (Avdibegović et al. 2014b, Halalisan et al. 2016, Pezdevšek Malovrh et al. 2019). Despite the existing research, there is an apparent lack of scientific work focusing exclusively on the issue of Pan-European criteria and indicators of SFM in BiH from a forest policy perspective.

Due to BiH's unique constitutional framework, there is neither a long-term strategy for forest development, nor a coherent forest policy, nor a forest law framework at the state level. Forest policy is decentralised and shaped by the entities (Republic of Srpska and FBiH) and the Brčko District. Institutions at these levels are responsible for shaping forest policy as well as forest legislation and its implementation (FAO 2015). Therefore, there is a need to analyse the possibilities of applying the Pan-European criteria for SFM in FBiH forestry. In this sense, this research represents a pioneering work based on empirical research in which the level of importance of and compliance with six criteria for SFM was analysed. In that sense, this paper aims to explain how the international process of development and application of the Pan-European criteria for SFM can contribute to the improvement of the situation in forestry and the creation of a consistent forest policy in FBiH.

MATERIALS AND METHODS

The Pan-European set of criteria and indicators for SFM consists of 6 criteria, 34 quantitative and 11 qualitative indicators (Forest Europe 2015). The Pan-European criteria and indicators for SFM are basic instruments for defining, applying and promoting SFM by providing relevant information for the development and evaluation of national forest policies, plans and programmes. They serve as a basis for collecting cross-sectoral data on forest management and as a means of communicating the forest sector to the general public. With their help, it is possible to monitor, evaluate and report on progress in SFM at regional and national levels (MCPFE 1998). In this sense, this paper analyses the level of familiarity of forestry professionals in FBiH (employees of public forest companies and institutions of public forest administration) in relation to the Pan-European criteria for SFM. In addition, the paper addresses the assessment of the level of compliance and importance of six Pan-European criteria for current forestry activities in FBiH (Table 1). It becomes clear that the paper focuses on three different aspects of the assessment:

1. Familiarity – indicates the level to which respondents are familiar with the Pan-European set of criteria for SFM;
2. Compliance – indicates the level of compliance of the Pan-European set of criteria for SFM with current forest management activities in FBiH;
3. Importance – indicates the level of importance of the Pan-European set of criteria for SFM for current forest management activities in FBiH.

A survey of university graduated forestry professionals was conducted in FBiH to determine their level of familiarity, level of compliance and level of importance regarding the set of six Pan-European criteria for SFM (Table 1). In 2018, public forest companies and institutions of public

Table 1. Pan-European criteria for sustainable forest management (Forest Europe 2020).

Criterion 1	Maintenance and appropriate enhancement of forest resources and their contribution to global carbon cycles
Criterion 2	Maintenance of forest ecosystem health and vitality
Criterion 3	Maintenance and encouragement of productive functions of forests
Criterion 4	Maintenance, conservation and appropriate enhancement of biological diversity in forest ecosystems
Criterion 5	Maintenance and appropriate enhancement of protective functions in forest management
Criterion 6	Maintenance of other socio-economic functions and conditions

forest administrations (Ministry of Agriculture, Water Management and Forestry of FBiH, Forestry Office of FBiH, Cantonal Forestry Offices) were contacted in order to obtain information on the number of employed university graduated forestry professionals in FBiH (N=538). Since the potential respondents are employees of the public institutions who are relatively easy to reach, it was decided to distribute the questionnaires to all identified university graduated forestry professionals, so that the sample size corresponded to the population size. The questionnaires were delivered in person to forest companies and public forest administration institutions. A total of 538 questionnaires were distributed and 360 completed questionnaires were returned (313 from public forest companies and 47 from public forest administration), representing response rate of almost 67%. The questionnaire was designed to provide a quantitative description of the trends, attitudes or opinions of the respondents in the sample, which allowed generalisation of the conclusions about the studied population (De Vaus 2002). The questionnaire consisted of five sections asking for information on socio-demographic characteristics of university graduated forestry professionals in FBiH (gender, age, education, number of years of work experience, type of institution where the respondent is employed), familiarity with the Pan-European criteria of SFM, assessment of the level of compliance and the level of importance of each of the six criteria of SFM by using the five-point Likert scale. The explanation of the set of Pan-European criteria for SFM with corresponding indicators was provided prior to the part where the respondents gave their assessment grade for the level of compliance and level of importance. The fourth section contained questions on the possible use of Pan-European criteria and indicators for SFM, on the responsible institutions for the implementation of Pan-European criteria

and indicators for SFM and on the responsible institution for data collection. The fifth section was dedicated to identifying possible difficulties in implementing the Pan-European criteria and indicators for SFM in FBiH. The questionnaire was tested among staff of public forest companies, institutions of public forest administration and staff of the Faculty of Forestry of the University of Sarajevo.

The collected data were entered into MS Excel 2016 and processed in the statistical analysis programme SPSS 22. The statistical analyses in this study were conducted in two stages. In the first stage, all the collected data were presented by using the frequency distribution, i.e., the selected location measures (mean, maximum and minimum). In the second stage, the Mann-Whitney U-test was used to test the differences between the respondents' assessments of the level of compliance and importance of Pan-European criteria for SFM for forest management activities in FBiH, according to gender, age, work experience, education and type of institution. Some of the variables used in these tests were recoded (Table 2). As the criteria of normal distribution and homogeneity of variance of the data were not met, non-parametric tests were used (Field 2009). Statistically significant differences were defined as $p<0.05$.

RESULTS AND DISCUSSION

Socio-Demographic Characteristics of Respondents

The socio-demographic characteristics of the respondents are shown in Table 3. It can be seen that the majority of the respondents are male, 77.8%. Despite the positive trend in the number of female students in forestry (FAO 2020), more men than women traditionally enrol in forestry faculties. The results of the latest survey

Table 2. Independent variables for the "Mann-Whitney U" non-parametric test.

Independent variables	Coded variables
Gender	1 - Male 0 - Female
Age	1 – up to 40 0 – more than 40
Work experience in forestry	1 – up to 10 0 – more then 10
Education	1 – Bologna system of education 0 – Pre-Bologna system of education
Type of institution	1 – Public forest company 0 – Public forest administration

show that most respondents perceive the forestry sector as a male domain and that the vast majority believe that the representation of women is not satisfactory (Forests in Women's Hands 2021).

As for the average age of the respondents, the results show that the respondents are on average 41 years old, while the youngest respondent was 22 years old and the oldest 65 years old. In terms of the age structure of employees, young employees are most represented in the age group between 20 and 40 years (57.5%), 12.1% of the respondents are middle-aged, while 30.40% of the respondents are in the age group between 51 and 65 years. The results obtained in this study are similar to the results of another study (e.g. Mutabdžija 2012).

Results also indicate that the largest group in the sample are forest engineers with a four-year university education (67.8%). The second largest group in terms of representation are Masters of forestry, making one-fifth of the sample (19.7%). Third are Bachelors of forestry making 6.9%, fourth is the group of respondents who belong to Masters of forestry sciences making 5%, and the smallest group were PhDs in forestry sciences making 0.6% of sample. In the future, a decrease in the number of engineers in the total number of forestry professionals in FBiH can be expected due to their retirement and the fact that the four-year forestry degree programme (pre-Bologna system of education) is no longer formally active in FBiH territory. This research has shown that the number of employed bachelor graduates in public forest companies is increasing, compared to the previous research (Mutabdžija 2012), and that 25 bachelor graduates have been hired. In addition, the majority of university graduated forestry professionals (86.9%) are employed in FBiH in public forest companies in FBiH, while 13.1% of the respondents are employees of public forest administration institutions.

On average, forestry professionals in FBiH have 13.7 years of work experience (1 year minimum and 38 years maximum). The data on the age structure and work experience of the respondents can make an important contribution to the planning of the educational policy of higher education institutions in the field of forestry in BiH. A high percentage of younger population among forest engineers/masters might indicate the need to reduce the number of vacancies for enrolment of forestry students in the near future. The decision on the number of enrolled students should be taken after a comprehensive analysis of all possible and available jobs in the FBiH forestry sector. Another step towards understanding and using this data should be in the direction of diversifying and expanding the teaching programmes at the Faculty of Forestry, as it is logical that forestry professionals with university diplomas will be forced to seek employment outside the forestry sector in the near future (Mutabdžija 2012).

Familiarity with the Pan-European Criteria for SFM

The average rate of familiarity with the Pan-European criteria for SFM among the respondents from the sample is 1.92. About one-third of the respondents (33.1%) are not at all familiar with the Pan-European criteria for SFM. Less than half of the respondents (43.7%) are slightly familiar, around one-fifth of the respondents (21.3%) are somewhat familiar, while only 2.0% of the respondents are very familiar with the Pan-European criteria for SFM (Figure 1).

Figure 2 shows the respondents' answers on familiarity with the Pan-European criteria for SFM by type of institution. It shows that the respondents' familiarity with the Pan-European criteria for SFM is slightly higher among respondents employed in public forest administration (30%) than among respondents employed in public forest

Table 3. Socio-demographic characteristics of the respondents (n=360).

| Variable	Category	Percentage of respondents
Gender	Male	77.8
	Female	22.2
Age	20-30 years	21.7
	31-40 years	35.8
	41-50 years	12.1
	51-60 years	27.9
	More than 60 years	2.5
Education	Bachelor	6.9
	Graduated engineer	67.8
	Master of forestry	19.7
	Master of forest sciences	5
	PhD	0.6
Work experience	Up to 10 years	47.6
	11-20 years	25.2
	21-30 years	19.9
	More than 30 years	7.3
Type of institution	Public forest company	86.9
	Public institutions of forest administration	13.1
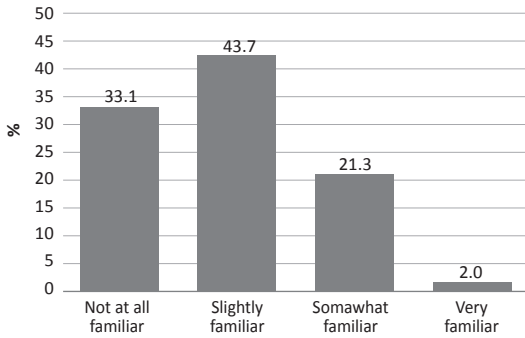
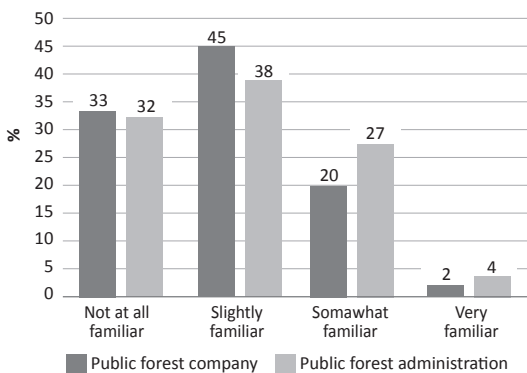**Figure 1.** Familiarity with the Pan-European criteria for SFM.

Figure 2. Familiarity with Pan-European criteria for SFM by the type of institution.

companies. However, the results of the Mann-Whitney U-test show that these differences between respondents from the different types of institutions are not statistically significant (p=0.709). This indicates that the majority of respondents are not at all familiar or only slightly familiar with the Pan-European criteria for SFM and that the type of institution they belong to has no influence on the level of familiarity. In view of this, it can be concluded that there is a need for lifelong learning and continuous improvement of existing knowledge about the Pan-European criteria and indicators for SFM.
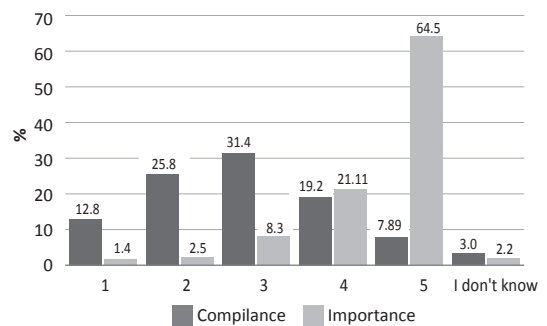
Assessment of Compliance and Importance of Pan-European Criteria for SFM with the Forest Management Activities in FBiH

The level of compliance and the level of importance of six Pan-European criteria for SFM were investigated using a Likert scale in the questionnaire. Figure 3 shows the distribution of answers related to the level of compliance and level of importance for Criterion 1 "Maintenance and appropriate enhancement of forest resources and their contribution to global carbon cycles with forest management practices". This criterion is defined by analysing indicators/information on forest area, growing stock, age structure and/or diameter distribution and forest

carbon, as well as policies, institutions and instruments to maintain and appropriately enhance forest resources and their contribution to global carbon cycles. The compliance of the Criterion 1 with the forest management activities in FBiH are considered poor and very poor (38.6%) or neutral (31.4%) by the majority of the respondents with the average ratings of 2.54. Further statistical analysis regarding the level of compliance, presented in Table A1 (see Appendix), related to the differences between ratings of compliance according to gender, age, working experience, education and type of institutions (Mann-Whitney U-test), shows that there are no statistically significant differences in the respondents' ratings. When it comes to the level of importance of Criterion 1, the majority of the respondents (over 85%) rate it as important or very important for forest management activities in the FBiH indicated by the average rating of 4.36. The results of Mann-Whitney U-test (Table A2 in the Appendix) for the level of importance showed that the gender (p=0.004) and educational level (p=0.035) have statistically significant influence on average ratings. In general, female respondents and respondents with diploma of pre-Bologna system of education, on average, gave higher rates of importance than male respondents and respondents with diploma of Bologna system of education.

It can be seen that there is a difference in the respondents' answers between the level of compliance and the level of importance for the Criterion 1. While the Criterion 1 is considered as very important in general, the respondents perceived the compliance level mostly as very poor. This implies the need for education on specific indicators related, among others, to the circulation and storage of carbon within the Criterion 1.

Some of the information required for the assessment of Criterion 1 can be found in various international and national information sources. In the latest Forest Europe reports for BiH (2020), the percentage of total forest area has remained quite stable and without major changes, and now stands at 54.9% of the total area, including a variety

Compliance	1 Very poor	2 Poor	3 Neutral	4 Good	5 Very Good
Importance	1 Not important	2 Slightly important	3 Neutral	4 Important	5 Very important

Figure 3. Assessment of compliance and importance of Criterion 1 "Maintenance and appropriate enhancement of forest resources and their contribution to global carbon cycles with forest management practices".
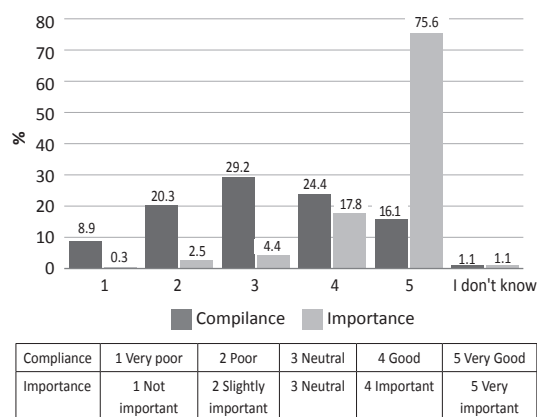
Figure 4. Assessment of compliance and importance of Criterion 2 "Maintenance of forest ecosystem health and vitality".

of land uses considered as other wooded land. However, the wood stock has steadily increased, reaching 230 m³ o.b. per ha in the public forests. The same data for soil biomass has been continuously reported since 2000 without any changes, so the trend cannot be assessed. Furthermore, no information was provided on the carbon stock in harvested wood products (Forest Europe 2020). The official data in the ministerial document Information on Forest Management in FBiH for 2021 and the Forest Management Plans for 2022 contain data on forest area, timber stock, age structure and/or diameter distribution, but no data on forest carbon stock (FMAWF 2022).

Figure 4 shows the distribution of answers related to the assessment of the level of compliance and importance of Criterion 2 "Maintenance of forest ecosystem health and vitality". This criterion is defined by analysing indicators/information on the deposition and concentration of air pollutants, soil condition, defoliation, forest damage, forest land degradation and policies, institutions and instruments to maintain forest ecosystem health and vitality of forest ecosystems. Almost 30% of the respondents had a neutral attitude regarding the compliance of Criterion 2, while over 40% of the respondents believe that Criterion 2 is good and very good in compliance with forest management practices, which is indicated with relatively high average ratings of 2.95. Similar to Criterion 1, further statistical analysis of the differences between ratings of compliance according to the independent variables shows that there are no statistically significant differences in the respondents' ratings - Table A3 (see Appendix).

On the other hand, the majority of the respondents (93.4%) believe that Criterion 2 is important and very important for forest management activities in FBiH, with the average ratings of 4.58 (Figure 4). The results of Mann-Whitney U-test (Table A4 in the Appendix) showed that the female respondents (p=0.006), the older (p=0.009) and more experienced respondents (p=0.001), those with diploma of pre-Bologna system of education (p=0.002) and respondents employed in public forest companies (p=0.0029) gave the higher average ratings to the level of importance for Criterion

2. Despite the relevance of Criterion 2, official statistics for the forestry in FBiH provide limited data on these concerns, which are mostly related to forest damage caused by forest fires or illegal logging (FMAWF 2022). Existing information needs to be improved by integrating data on deposition and concentration of air pollutants, soil condition, defoliation and degradation of forest areas, and compiling them into a single comprehensive database at FBiH level.

Figure 5 shows distribution of answers of the respondents' attitudes related to the assessment of the level of compliance and importance of Criterion 3 "Maintenance and encouragement of productive functions of forests". This criterion is defined by analysing indicators/information on increment and felling, roundwood, non-wood goods and services, as well as policies, institutions and instruments to maintain and encourage the productive functions of forests. The results show that the majority of the respondents (46.9%) believe that Criterion 3 is good and very good in compliance with forest management practices in FBiH, while 30.5% of the respondents have a neutral attitude on this issue. This attitude is supported by the average grade of the compliance of 3.13. As with the previous criteria, statistical analysis of the differences between compliance ratings as a function of the independent variables (gender, age, work experience, education and type of institution) shows that there are no statistically significant differences in the respondents' ratings - Table A5 (see Appendix).

Regarding the assessment of the importance of Criterion 3, the majority of the respondents (93.3%) consider that this criterion is important and very important for forest management activities in FBiH (average rating 4.58). The results of the Mann-Whitney U-test (Table A6 in the Appendix) for the level of importance show that gender (p=0.017) and level of education (p=0.047) have a statistically significant influence on the average ratings. Similar to Criterion 1 and Criterion 2, female respondents and those with a degree from the pre-Bologna system rate the importance of Criterion 3 higher on average than male respondents and those with a degree from the Bologna system. The importance of the productive functions of forests is reflected in the fact that many
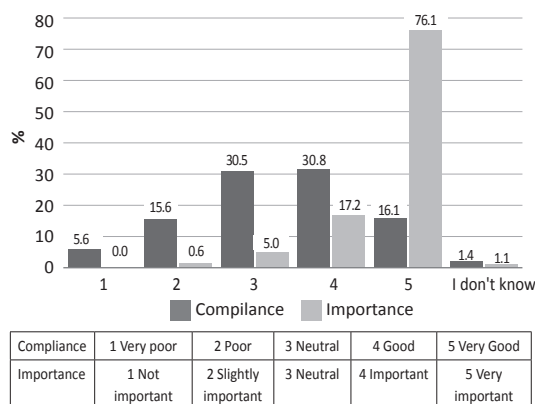

Figure 5. Assessment of the compliance and importance of Criterion 3 "Maintenance and encouragement of productive functions of forests".

local communities depend directly or indirectly on forests and forest products and services. The continuous and sustainable provision of forest services is linked to their productive capacities, which must not be exceeded, otherwise ecosystem disruption could occur. In this sense, it is necessary to plan and implement activities that ensure the sustainable use of forest products and services in a way that does not impair the functioning of forest ecosystems. In order to meet society's needs for forest products (timber and non-timber) and services (ecosystem service bundles), it is necessary to follow trends in social, economic and technological development, as these are directly related to society's changing demands on forests. Forest management activities must be carefully balanced with the aim of meeting the needs of current generations without destroying or compromising the ability of future generations to use the productive functions of the forest, while respecting the traditional needs and uses of forests by local communities and populations (Avdibegović et al. 2022). Although the vast majority of the respondents consider this criterion important, official data only include statistics on increment, annual allowable harvest and logging, but no information on non-timber goods and services (FMAWF 2022).

Figure 6 shows the results of the respondents' attitudes towards assessing compliance of Criterion 4 "Maintenance, conservation and appropriate enhancement of biological diversity in forest ecosystems" with the forest management activities in FBiH. This criterion is defined through analysis of the indicators/information on tree species diversity, regeneration, naturalness, introduced tree species, deadwood, genetic resources, forest fragmentation, threatened forest species, protected forests, common forest bird species and policies, institutions and instruments for conservation, and preservation and adequate enhancement of biodiversity in forest ecosystem. The average rating for this criterion is 2.92 and more than 39% of the respondents indicated that Criterion 4 is good and very good in terms of compliance with forest management activities in FBiH. Statistical analysis did not reveal any statistically significant differences in respondents' ratings in terms of differences in compliance according to the selected variables - Table A7 (see Appendix).
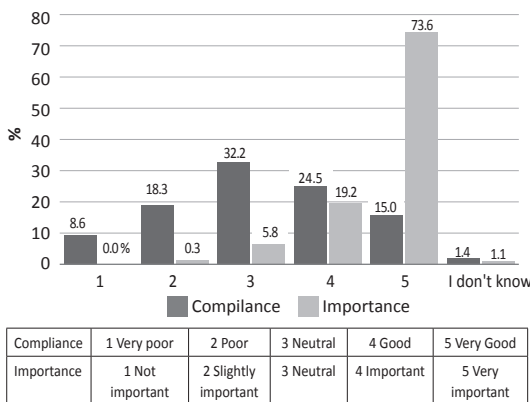
The assessment of the importance of Criterion 4 for forest management activities in FBiH (Figure 4) showed that 92.3% of the respondents rated this criterion as important or very important, with an average rating of 4.54. The results of the Mann-Whitney U-test (Table A8 in the Appendix) for the level of importance showed that gender (p=0.001) and age (p=0.020) had a statistically significant influence on the average ratings. On average, female respondents and respondents older than 40 years gave higher ratings of importance of Criterion 4 for forest management activities in FBiH. Currently, information on indicators for tree species diversity, regeneration, naturalness, introduced tree species, deadwood, genetic resources, threatened forest species, protected forests and common forest bird species is not included in the official data (FMAWF 2022). According to the latest Forest Europe report, 4.0% of forest and other wooded land is protected for biodiversity conservation (MCPFE classes 1 and 2) (Forest Europe 2020). Data on threatened forest species are available in the Red List of Threatened Wild Species and Subspecies of Plants in FBiH (Greenway 2013).

Figure 7 shows the distribution of the respondents' answers in relation to the assessment of compliance with Criterion 5 "Maintenance and appropriate enhancement of protective functions in forest management". The definition of this criterion is based on the analysis of indicators/information on protective forests (protection of soil, water and other ecosystem functions - infrastructure and managed natural resources to prevent natural disasters) and policies, institutions and instruments to maintain and adequately improve protective functions in forest management. In the survey conducted, 49.2% of the respondents evaluated Criterion 5 as good and very good in terms of compliance with forest management practises in FBiH, while 26.7% of respondents had a neutral attitude towards this criterion, with an average rating score of 3.09. Further statistical analysis of the differences between ratings of compliance according to the independent variables, shows that there are no statistically significant differences in the respondents' ratings - Table A9 (see Appendix).
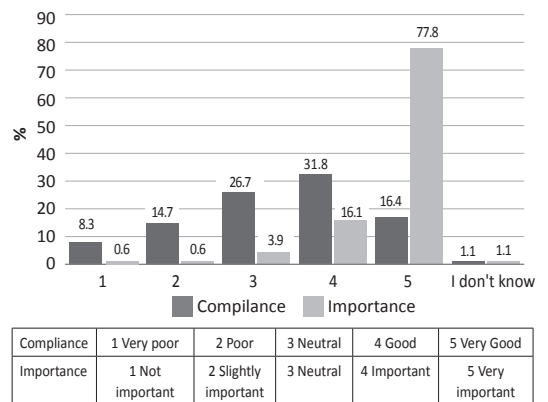

Compliance	1 Very poor	2 Poor	3 Neutral	4 Good	5 Very Good
Importance	1 Not important	2 Slightly important	3 Neutral	4 Important	5 Very important

Figure 6. Assessment of the compliance and importance of Criterion 4 "Maintenance, conservation and appropriate enhancement of biological diversity in forest ecosystems".

Compliance	1 Very poor	2 Poor	3 Neutral	4 Good	5 Very Good
Importance	1 Not important	2 Slightly important	3 Neutral	4 Important	5 Very important

Figure 7. Assessment of the compliance and importance of Criterion 5 "Maintenance and appropriate enhancement of protective functions in forest management".

The vast majority of respondents (93.9%) assessed Criterion 5 as important and very important, with an average score of ratings being 4.59 (Figure 7). The results of Mann-Whitney U-test (Table A10 in the Appendix) for the level of importance showed that gender (p=0.000), age (p=0.012) and work experience (p=0.040) had a statistically significant influence on the average ratings. In general, female respondents, older respondents and respondents with more work experience gave higher average importance ratings for Criterion 5. The data in the latest Forest Europe report shows that no information was provided on forests with designated protective functions for BiH (Forest Europe 2020), and there is no available information on protective functions of forests in the official report (FMAWF 2022).

Figure 8 displays the distribution of responses given by respondents on the assessment of the compliance of Criterion 6 "Maintenance of other socioeconomic functions and conditions". This criterion is defined by analysing indicators/information on forest ownership, forest sector contribution to GDP, net revenue, investment in forests and forestry, forest sector workforce, occupational safety and health, wood consumption, trade in wood, wood energy, recreation in forests, and policies, institutions and instruments to sustain other socio-economic functions and conditions. Less than 40% of the respondents indicated that Criterion 6 was good and very good in compliance with forest management activities in FBiH, with an average score of 2.89 for the ratings. Further statistical analysis showed, as in all previous cases, that the differences between compliance ratings by independent variables were not statistically significant - Table A11 (see the Appendix).

When it comes to the assessment of the importance of Criterion 6, 89.5% of the respondents had the opinion that this criterion is important and very important, with an average value of ratings of 4.42. The results of Mann-Whitney U-test (Table A10 in the Appendix) for the level of importance showed that gender (p=0.004), age (p=0.024), work experience (p=0.013), and education (p=0.002) have statistically significant influence on average ratings. Accordingly, female respondents, older respondents, respondents with more work experience and those with a diploma from the pre-Bologna education system gave higher average ratings of importance for Criterion 6. According to data in the Ministry's official report, 4,825 people are employed in the forestry sector in FBiH, while data on the forestry sector's contribution to GDP, occupational safety and health, wood consumption, wood trade, wood energy and forest recreation are not available (FMAWF 2022).

The comparison of differences in average scores was carried out to identify areas for further activities to improve the general understanding of the Pan-European criteria for SFM among FBiH forestry professionals. The average difference for the importance and compliance scores (1.60) was set as the breaking point for dividing the criteria into two groups: those where respondents expressed a low level of knowledge and understanding (>1.60) and those with the better level of knowledge and understanding (<1.60). Figure 9 shows the results of the comparison of the average scores for the compliance, importance and the differences
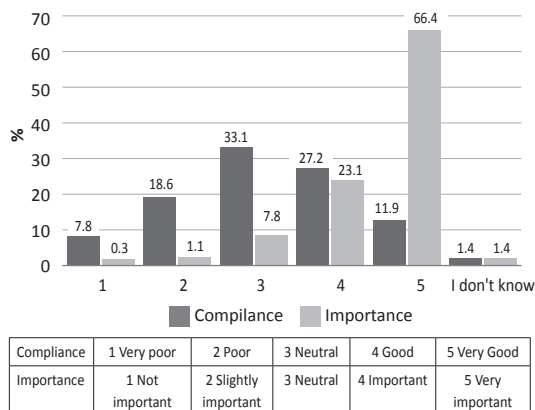

Compliance	1 Very poor	2 Poor	3 Neutral	4 Good	5 Very Good
Importance	1 Not important	2 Slightly important	3 Neutral	4 Important	5 Very important

Figure 8. Assessment of the compliance and importance of Criterion 6 "Maintenance of other socioeconomic functions and conditions".

between ratings of six Pan-European criteria for SFM. The criteria with an average score difference of more than 1.60 are considered to be those where respondents expressed a low level of knowledge and understanding. Criterion 1, Criterion 2 and Criterion 4 belong to this category. On the aspects included in these criteria, specific forest policy instruments should be created focusing on continuous training, knowledge generation and information sharing among forest professionals in FBiH. In contrast, the criteria with an average score difference of less than 1.60 are treated as those for which the respondents indicated a better understanding. This group consists of Criterion 3, Criterion 5 and Criterion 6. Similar to the previous group, a specific forest policy instruments should be created to improve coordination between different institutional and market actors for information exchange and to make joint efforts to integrate the basic elements of Pan-European criteria for SFM in forest management activities in FBiH.
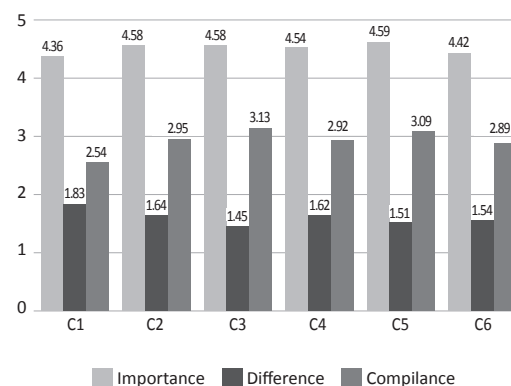

Figure 9. Average ratings of compliance and importance of six Pan-European criteria for SFM.

CONCLUSIONS

This study provides the findings of a survey of forestry professionals in FBiH to determine their attitudes and understanding of Pan-European criteria for SFM. The aspects of familiarity, compliance, and importance were explored, and an understanding of how the set of criteria might be utilised to enhance forest management activities in FBiH was elaborated. The general conclusion is that forestry professionals in FBiH have a relatively low level of familiarity with the Pan-European criteria for SFM, and that they express their low level of compliance with current forest management activities in FBiH, but they see the criteria as a useful and necessary tool for improving the forest sector in FBiH.

Considering the scope of the study, valuable data were obtained on the socio-demographic characteristics of forestry professionals in FBiH. According to the results, their average age is 41 years and their average work experience is just over 13 years. It can be said that this is a young population, most of whom will be working in the next 20 years or so. This kind of data is important for academic institutions when it comes to adjusting enrolment policies and also for labour market expectations and trends. As forestry professionals are a relatively young population, forest policy activities focusing on information and knowledge generation should be undertaken for them as a target group to improve their understanding of the Pan-European SFM criteria.

Concerning the low level of familiarity with the set of criteria, it can be concluded that there is a lack of understanding of international and European forest policy activities. This is understandable for the group of senior forestry professionals, who have not had the opportunity to study the subject of forest policy in the curriculum. On the other hand, these results show that adequate lifelong learning programmes in forestry need to be established and offered in FBiH. In addition to educational institutions (secondary forestry schools and forestry faculties),

professional associations (through the process of licencing forestry professionals for specific activities) should also play an important role in the continuous education of forestry professionals. Having in mind that the process of developing and applying Pan-European SFM criteria has been ongoing for almost three decades, it is clear that the exchange of experience, networking and coordination, focused on the implementation of these criteria in FBiH forestry, can improve current forest management activities and enrich the monitoring and assessment tools currently in use.

Since the majority of the respondents indicated that current forest management activities are insufficiently compliant with Pan-European criteria for SFM, significant changes to current forest policy activities in FBiH are required to adopt and integrate these tools into ongoing forest policy processes and forest management activities in general. Priority should be given to initiatives to educate and share information among all relevant stakeholders, especially forestry professionals responsible for monitoring and assessing progress in implementing the principles of SFM. It is also important to incorporate the requirements of the Pan-European criteria for SFM into the strategic and operational framework of forestry sector. In this respect, the relevant FBiH forestry institutions should initiate the joint process of developing new indicators and adopting existing set of SFM indicators. All administrative levels and forestry-related institutions should work together to carry out these activities. Furthermore, the implementation of the Pan-European SFM criteria in FBiH forestry requires the collection and analysis of data relevant to the specific indicators. Data for some of the quantitative indicators mentioned are already collected by the relevant institutions, while data for others are dispersed or missing altogether. In this regard, the database for analysing all relevant data on SFM activities, established in accordance with Pan-European criteria for SFM, is essential for their implementation, monitoring and reporting of the SFM activities in FBiH.

Appendix A

Table A1. Results of the Mann-Whitney U-test for the dependent variable Assessment of compliance of Criterion 1 Maintenance and appropriate enhancement of forest resources and their contribution to global carbon cycles.

Dependent variable: Assessment of compliance of Criterion 1 "Maintenance and appropriate enhancement of forest resources and their contribution to global carbon cycles"			
Independent variable	U	z	p
Gender: male and female	10550.000	-0.798	0.425
Age: up to 40 years and over 40 years	15191.000	-0.223	0.824
Work experience: up to 10 years, more than 10 years	15615.000	-0.290	0.772
Education: pre-Bologna system and Bologna system	12452.000	-0.254	0.799
Type of institution: forest company and public forest administration	6843.500	-0.776	0.438

Table A2. Results of the Mann-Whitney U-test for the dependent variable Assessment of importance of Criterion 1 Maintenance and appropriate enhancement of forest resources and their contribution to global carbon cycles.

Dependent variable: Assessment of importance of Criterion 1 "Maintenance and appropriate enhancement of forest resources and their contribution to global carbon cycles"			
Independent variable	U	z	p
Gender: male and female	9049.500	-2.893	0.004
Age: up to 40 years and over 40 years	13956.000	-1.667	0.095
Work experience: up to 10 years, more than 10 years	14720.000	-1.334	0.182
Education: pre-Bologna system and Bologna system	11004.000	-2.110	0.035
Type of institution: forest company and public forest administration	6871.000	-0.804	0.421

Table A3. Results of the Mann-Whitney U-test for the dependent variable Assessment of compliance of Criterion 2 Maintenance of forest ecosystem health and vitality.

Dependent variable: Assessment of compliance of Criterion 2 "Maintenance of forest ecosystem health and vitality"			
Independent variable	U	z	p
Gender: male and female	10899.500	-0.369	0.712
Age: up to 40 years and over 40 years	14553.500	-0.894	0.371
Work experience: up to 10 years, more than 10 years	15165.000	-0.755	0.450
Education: pre-Bologna system and Bologna system	12596.000	-0.088	0.930
Type of institution: forest company and public forest administration	7178.500	-0.268	0.789

Table A4. Results of the Mann-Whitney U-test for the dependent variable Assessment of importance of Criterion 2 Maintenance of forest ecosystem health and vitality.

Dependent variable: Assessment of importance of Criterion 2 "Maintenance of forest ecosystem health and vitality"			
Independent variable	U	z	p
Gender: male and female	9230.500	-2.751	0.006
Age: up to 40 years and over 40 years	13205.000	-2.625	0.009
Work experience: up to 10 years, more than 10 years	12951.000	-3.466	0.001
Education: pre-Bologna system and Bologna system	10357.000	-3.040	0.002
Type of institution: forest company and public forest administration	6087.000	-2.187	0.029

Table A5. Results of the Mann-Whitney U-test for the dependent variable Assessment of compliance of Criterion 3 Maintenance and encouragement of productive functions of forests.

Dependent variable: Assessment of compliance of Criterion 3 "Maintenance and encouragement of productive functions of forests"			
Independent variable	U	z	p
Gender: male and female	10996.000	-0.251	0.802
Age: up to 40 years and over 40 years	14489.000	-0.964	0.335
Work experience: up to 10 years, more than 10 years	14754.000	-1.182	0.237
Education: pre-Bologna system and Bologna system	11539.500	-1.309	0.191
Type of institution: forest company and public forest administration	6961.500	-0.598	0.550

Table A6. Results of the Mann-Whitney U-test for the dependent variable Assessment of importance of Criterion 3 Maintenance and encouragement of productive functions of forests.

Dependent variable: Assessment of importance of Criterion 3 "Maintenance and encouragement of productive functions of forests"			
Independent variable	U	z	p
Gender: male and female	9464.000	-2.385	0.017
Age: up to 40 years and over 40 years	14222.500	-1.391	0.164
Work experience: up to 10 years, more than 10 years	14362.500	-1.777	0.076
Education: pre-Bologna system and Bologna system	11130.500	-1.991	0.047
Type of institution: forest company and public forest administration	7299.000	-0.096	0.924

Table A7. Results of the Mann-Whitney U-test for the dependent variable Assessment of compliance of Criterion 4 Maintenance, conservation and appropriate enhancement of biological diversity in forest ecosystems.

Dependent variable: Assessment of compliance of Criterion 4 "Maintenance, conservation and appropriate enhancement of biological diversity in forest ecosystems"			
Independent variable	U	z	p
Gender: male and female	10588.000	-0.442	0.659
Age: up to 40 years and over 40 years	14343.000	-0.757	0.449
Work experience: up to 10 years, more than 10 years	15499.500	-0.058	0.953
Education: pre-Bologna system and Bologna system	12359.500	-0.141	0.888
Type of institution: forest company and public forest administration	5962.000	-1.808	0.071

Table A8. Results of the Mann-Whitney U-test for the dependent variable Assessment of importance of Criterion 4 Maintenance, conservation and appropriate enhancement of biological diversity in forest ecosystems.

Dependent variable: Assessment of importance of Criterion 4 "Maintenance, conservation and appropriate enhancement of biological diversity in forest ecosystems"			
Independent variable	U	z	p
Gender: male and female	8550.000	-3.289	0.001
Age: up to 40 years and over 40 years	13079.000	-2.322	0.020
Work experience: up to 10 years, more than 10 years	13918.500	-1.895	0.058
Education: pre-Bologna system and Bologna system	11148.000	-1.715	0.086
Type of institution: forest company and public forest administration	6553.500	-0.982	0.326

Table A9. Results of the Mann-Whitney U-test for the dependent variable Assessment of compliance of Criterion 5 Maintenance and appropriate enhancement of protective functions in forest management.

Dependent variable: Assessment of compliance of Criterion 5 "Maintenance and appropriate enhancement of protective functions in forest management"			
Independent variable	U	z	p
Gender: male and female	10558.500	-0.479	0.632
Age: up to 40 years and over 40 years	15026.000	-0.025	0.980
Work experience: up to 10 years, more than 10 years	15338.000	-0.228	0.819
Education: pre-Bologna system and Bologna system	12285.500	-0.228	0.820
Type of institution: forest company and public forest administration	6621.500	-0.787	0.431

Table A10. Results of the Mann-Whitney U-test for the dependent variable Assessment of importance of Criterion 5 Maintenance and appropriate enhancement of protective functions in forest management.

Dependent variable: Assessment of importance of Criterion 5 "Maintenance and appropriate enhancement of protective functions in forest management"			
Independent variable	U	z	p
Gender: male and female	8049.500	-4.087	0.000
Age: up to 40 years and over 40 years	12983.500	-2.511	0.012
Work experience: up to 10 years, more than 10 years	13835.000	-2.050	0.040
Education: pre-Bologna system and Bologna system	11420.500	-1.402	0.161
Type of institution: forest company and public forest administration	6204.000	-1.621	0.105

Table A11. Results of the Mann-Whitney U-test for the dependent variable Assessment of compliance of Criterion 6 Maintenance of other socioeconomic functions and conditions.

Dependent variable: Assessment of compliance of Criterion 6 "Maintenance of other socioeconomic functions and conditions"			
Independent variable	U	z	p
Gender: male and female	10851.500	-0.113	0.910
Age: up to 40 years and over 40 years	14489.000	-0.602	0.547
Work experience: up to 10 years, more than 10 years	14434.000	-1.181	0.238
Education: pre-Bologna system and Bologna system	11336.000	-1.340	0.180
Type of institution: forest company and public forest administration	6694.500	-0.675	0.500

Table A12. Results of the Mann-Whitney U-test for the dependent variable Assessment of importance of Criterion 6 Maintenance of other socioeconomic functions and conditions.

Dependent variable: Assessment of importance of Criterion 6 "Maintenance of other socioeconomic functions and conditions"			
Independent variable	U	z	p
Gender: male and female	8771.500	-2.897	0.004
Age: up to 40 years and over 40 years	13085.500	-2.252	0.024
Work experience: up to 10 years, more than 10 years	13359.000	-2.471	0.013
Education: pre-Bologna system and Bologna system	10023.500	-3.071	0.002
Type of institution: forest company and public forest administration	6613.000	-0.855	0.393

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