

Strategic Directions for Strengthening Sustainability of Forestry Workforce

Mario Šporčić, Matija Landekić, Zdravko Pandur, Marin Bačić, Marijan Šušnjar, David Mijoč

Abstract

Today in many countries and regions, forestry sector deals with a considerable shortage of forestry workers and faces the serious challenge of ensuring a qualified and sustainable workforce. Current global processes and structural changes, such as emigration from rural areas, aging of the population, unfavorable age structure of existing employees, negative demographic trends (migrations, decline in birth rate, negative natural increase, etc.), lack of interest in the so-called 3D (dirty, dangerous and demeaning) jobs, low cost of labor and others, significantly contribute to such an adverse situation. Additionally, forestry work, especially wood harvesting, represents a very risky, professionally highly demanding and physically extremely intensive activity, which is regularly classified as one of the most dangerous occupations with a high proportion of serious injuries, fatalities and occupational diseases. For these reasons, the forestry profession is considered unattractive, and the job of a forestry worker undesirable. All of this makes finding the people interested in these jobs very difficult, and the task of ensuring the necessary workforce for all regular activities in sustainable forest management becomes very hard. In this paper, based on the surveys carried out in the Federation of Bosnia and Herzegovina (FB&H), i.e. evaluation of forestry workforce sustainability factors, and on the study of available strategic documents, policies and case studies, strategic directions aimed at strengthening the sustainability of forestry workforce were elaborated. The sustainability factors were observed in three categories related to: a) stronger recruiting in forestry, b) more successful retention of forestry workers, and c) higher work commitment of forestry workers. Established rankings, together with other findings, were used to define four separate strategic directions: (1) Direct financial strategy, which emphasizes direct monetary payments to workers and is oriented towards labor productivity, (2) Indirect financial strategy, which focuses more on providing indirect material gains to workers and the quality of performed work, (3) Educational strategy, aimed at the education and training of workers, and (4) Technical-technological strategy, aimed at increasing the mechanization in forest operations thus reducing the demand for labor. The paper elaborates the basic starting points and main characteristics (priorities, measures and activities, stakeholders, responsible authorities, etc.) of each strategic direction considering the possibility and conditions of their implementation in national forestry sector. The objective of the paper is to raise the required awareness of the forestry workforce issues, its position and status, and also to provide foundations for enhancing the attractiveness of forestry work and improving the overall sustainability of the forestry workforce. The results of the study point out the critical issues and provide valuable insights that can help in formulating effective policies and strategies for the future.

Keywords: forestry, sustainability, workforce, strategy, recruiting, Federation of Bosnia and Herzegovina

1. Introduction

Sustainable development or sustainability can be defined as the ability to maintain the balance of certain processes or conditions within a system, i.e. as »the ability of a living entity (either biological /biosphere/,

or social /society/) or a process that these entities co-produce through their existence and actions, to (self) maintain, (self)reproduce, (self)renew themselves through the way of living and acting« (Lay 2005). In the economic sense, sustainability means avoiding major disruptions and breakdowns, with measures

against instability and discontinuity (Pravdić 1998). In forestry, sustainable management of forests and forest land includes the application of the principles by which forests are managed for the current and future fulfillment of appropriate ecological, economic and social functions at the local, national and global level, respecting the socioeconomic importance of forests and their contribution to rural development (according to Croatian Forest Act, OG 101/23). Thereon, a qualified, highly efficient, stable and sustainable workforce in forestry is also one of the absolutely essential prerequisites for sustainable forest management as a fundamental principle of modern forestry planning and management.

According to some estimates, around 13.7 million workers are formally (legally) employed in forestry today (ILO 2021), with the annual felling volume estimated at 3.9 billion m³ of wood (Forest Research 2022). Forestry work, especially wood harvesting, is a very risky, professionally highly demanding and physically extremely intensive activity. Work in a natural environment with the frequent use of hand tools and machines exposes forestry workers to the influence of significant physical, psychological and environmental factors. At the same time, dangerous working conditions, frequent injuries and occupational diseases, characteristics of the workplace and the subject of work, the duration and structure of working hours, and extreme physical exertion constitute a permanent risk for preserving the health and working ability of forestry workers (Landekić 2010, Landekić et al. 2023). In most countries, forestry work is classified as one of the most dangerous occupations with a high proportion of serious injuries, fatalities and occupational diseases (EU-OSHA 2008, Adams et al. 2014, Şafak et al. 2024) related to the muscular, skeletal, nervous and cardiovascular systems and hearing impairments (Gallis 2006, Bovenzi 2008, Arman et al. 2022, Camargo et al. 2022). Eurostat reports that workers in forestry and logging in Central Europe (EU 27) suffered 80 fatal and 12,031 nonfatal accidents in 2021 (Eurostat 2024a, 2024b). Accidents most commonly occur during motor-manual felling and wood processing, which is still significantly present in many countries (Efthymiou 2008, Robb et al. 2022, FAO/ILO/UN 2023). Furthermore, work in forestry, especially in developing countries, often includes seasonal and/or informal employment, low safety standards, low wages, poor training system, weak social protection, separation of workers from their families, staying in isolated camps (containers), etc. (ILO 2019). Also, it is believed that working conditions in wood harvesting have a negative effect on the mental health of workers, causing

anxiety, nervousness, insomnia, etc. (Lotfalian et al. 2012).

The forestry sector today deals with a great shortage of forestry workers and faces a serious challenge of securing a qualified and sustainable workforce. The total number of forestry workers in Europe decreased by 18% in the period from 2008 to 2016 (UNECE/FAO 2020), with many studies warning about a further steep decline in their numbers in many countries (Proteau 2008, Tsioras 2010, 2012, Bernasconi and Schroff 2011, Cacot et al. 2015, PLCM 2019, He et al. 2021, Lippe et al. 2022). Further to the above, current global processes and structural changes, such as emigration from rural areas, which traditionally represent the main »pool« for finding and hiring forestry workers, the aging of the workforce and the unfavorable age structure of existing employees, together with other negative demographic trends (migrations, decline in birth rate, negative natural increase, etc.), significantly contribute to such an adverse situation. Today, the world of work is also acutely characterized by the lack of interest in the so-called 3D (dirty, dangerous and demeaning) or »black collar« jobs, which include physically demanding, dangerous and dirty occupations (Landekić et al. 2017). Younger generations, therefore, often consider the work in forestry, especially the jobs of loggers, tractor operators, choke setters, etc., to be humiliating and look on forestry workers as a specific subculture that is quite marginalized in society. This additionally makes the profession even more unattractive, and the job of a forestry worker an undesirable workplace (Tsioras 2010, Błuszkowska and Nurek 2014). All of this makes finding the people interested in these jobs and ensuring the necessary workforce for all regular activities in sustainable forest management significantly more difficult. This certainly points to the seriousness and complexity of the workforce issue and the shortage of production workers in forestry, that is, to the exceptional need for stronger recruitment of forestry workers that would contribute to the sustainability of the workforce in forestry.

In this paper, on the basis of surveys carried out in the Federation of Bosnia and Herzegovina (FB&H), covering the reflections of forestry sector employees (forestry workers, officials and experts) on what is needed for attracting more new workers to forestry, the strategic directions for stronger worker recruitment aimed at strengthening the forestry workforce sustainability are elaborated and presented. The results of the research include the opinions of selected groups of respondents (forestry workers and experts employed in forestry companies and governmental

forestry institutions) assessing the influence of a number of factors that can, to a greater or lesser extent, contribute to increased interest in forestry work, i.e. to a better sustainability of the necessary forestry workforce. Their views were analyzed regarding a set of factors concerning: a) stronger recruiting in forestry, b) more successful retention of workers, and c) higher commitment of forestry workers. Based on the results obtained, i.e. the ranking of the evaluated factors, together with other analysis conducted, four main strategic directions for strengthening the sustainability of the forestry workforce were established. The paper elaborates the main characteristics (priorities, measures and activities, stakeholders, responsible authorities, etc.) of each strategic direction considering the possibility and conditions of their implementation in the national forestry sector. The objective of the paper is to raise the required awareness of the forestry workforce issues, its position and status, and also to provide foundations that can be an important contribution to increasing the attractiveness of forestry work and occupation and overall improvement of the forestry workforce sustainability.

2. Material and Methods

The research was conducted in the Federation of Bosnia and Herzegovina (FB&H) that, together with two other entities (Republic of Srpska and District Brčko), constitutes the state of Bosnia and Herzegovina (B&H). The Federation of Bosnia and Herzegovina covers 51% of the total B&H territory. The Federation consists of 10 cantons with public forestry companies founded in each canton (except in one due to very small forest area) for managing state forests. The total area of state forests amounts to 1,233,808 ha (82% of the total forest area, or 58% of the total FB&H territory), with the annual cut of about 3.1 million m³. In wood harvesting, the semi-mechanized (motor-manual) operations still prevail, most often including felling and processing with chainsaws and also extracting and hauling with skidders or adapted farm tractors (FMAWMF 2021). According to public records, apart from state forestry companies, there are 284 private forestry companies (entrepreneurs, i.e. small businesses) operating in forestry and logging (FSO 2020), with the total number of employees in FB&H forestry sector of about 5224 (FSO 2021).

The survey was carried out in public forestry companies, private forestry companies and state forestry institutions (administrative, scientific and educational, professional, etc.), including a total of 1145 distributed questionnaires (which complies with 95% confidence

level and ± 5 significance according to DeVaus 2002). The questionnaire was constructed based on the review of literature, human resource management postulates, and recent findings in forestry science and practice. The reliability of the questionnaire was assessed as satisfactory with Cronbach's alpha coefficient of 0.764, and the research was approved by the Ethical Committee of the University of Zagreb Faculty of Forestry and Wood Technology (protocol code EP/02-21, 22 September 2021). The complete questionnaire is presented in the doctoral thesis of Mijoč (2022).

The questionnaire, apart from introductory section and certain general questions on respondents and forestry occupation, includes evaluation of the factors important for workforce sustainability as the main part of the survey. The respondents were asked to evaluate, by using a 5-point Likert scale, a set of sustainability factors related to: a) stronger recruiting in forestry, b) more successful retention of workers, and c) higher work commitment of forestry workers. Distribution of questionnaires and data collection were carried out with the help of designated contact persons (forestry managers in public enterprises possessing organizational authority) as mediators. The survey was conducted during 2021 in nine public forestry companies, 26 private forestry companies, and in 17 out of 25 targeted forestry institutions. Three separate groups of respondents were included in the research:

- forestry workers employed in public and private companies
- professional and technical staff in forestry companies
- experts in state forestry institutions.

Detailed findings for specific groups of respondents regarding different questions included in the survey can be found in the papers published by Šporčić et al. (2023, 2024)

Based on a total of 435 questionnaires received and analyzed from 268 forestry workers (return rate 39.7%), 137 forestry professionals (return rate 38.1%), and 30 officials of forestry institutions (return rate 27.3%), ranks of specific factors for strengthening the workforce sustainability in forestry were determined. Data processing was performed using MS Office Access and Excel software. The established rankings of sustainability factors in three observed categories (recruiting, retaining and work commitment) were used as the basis for developing possible alternative strategic directions aimed at upgrading labor force sustainability in forestry. Development of the defined strategic directions additionally included investigation of domestic and foreign examples, i.e. case studies of

successful approaches and policies in management and retention of human resources in forestry, and also the analysis of available strategic, program and operational documents of the sector, human resources and employment policies, national forest management plans, etc. (results available in Mijoč 2022). By this, good practice examples were highlighted and additional inputs were gained for developing possible »scenarios« in approaching the problem of forestry workers shortage, i.e. defining possible strategic approaches to strengthening the sustainability of the forestry workforce. The analysis resulted in the development of four separate strategic directions. The elaboration of strategic directions presented in the paper defines their basic starting points and characteristics, main goals, measures, activities, stakeholders, authorities, financial costs, indicators, etc.

3. Results

3.1 Ranking of Workforce Sustainability Factors

The workforce sustainability factors evaluated in the survey questionnaires were defined on the basis of a systematic and thorough review of the scientific and professional literature on human resources and potentials, and also through previously conducted consultations with people directly involved in the process of wood harvesting in FB&H (forestry managers, forestry entrepreneurs, executives of wood harvesting companies, forestry workers, loggers and tractor operators).

Workforce sustainability factors basically include possible instruments and measures that can contribute to the quality and stability of the labor force, i.e. ensure harmony between the outflow and inflow of qualified forestry workers. These factors are numerous and difficult to classify precisely. In this study, the evaluated elements were grouped into three categories:

- factors for stronger recruitment
- factors for stronger retention
- factors for higher work commitment.

Although certain factors could be easily aligned in more than just one group (e.g., adequate salary is important for both recruiting and retention) an effort was made to avoid repeating the same elements in several categories.

The defined sustainability factors were evaluated using a 5-point Likert scale (1 – No impact at all; 5 – Very strong impact) by the mentioned groups of respondents. The ranking of individual factors was determined based on the share of their ratings 4 and 5 (4

– has a significant impact; 5 – has a very strong impact), and the established ranks are given from the factors with the largest share of these ratings to those with the smallest share of these ratings (Tables 1 to 3). The portion of the individual respondent group answers in the established rankings ranged from 6.6–7.1% for institutions, 31.8–32.2% for companies, and from 60.7–61.4% for forestry workers. Therefore, the forestry workers and their answers or opinions had the greatest influence on the obtained order, i.e. the ranking of the workforce sustainability factors.

3.1.1 Factors for Stronger Recruitment of Forestry Workers

Factors for successful recruiting encompass elements that affect job appeal and attract new workers, i.e. increase interest for the occupation and employment in forestry. Table 1 presents the ranks of evaluated factors, ordered by their significance, i.e. influence (1 – factor with the greatest influence, 2 – factor rated as the second most significant, etc.). For each factor, it is also indicated whether it represents a financial (F) or non-financial (N) type of compensation (C). Financial compensation includes direct and indirect material gains of the worker (e.g. salary, bonuses and incentives, scholarships, pension and health insurance payments, benefits, rewards, etc.), while non-financial compensation does not imply such monetary payments, although it may denote a certain cost for the employer (e.g. work conditions, safety at work, employee participation, job design, flexible working hours, training, etc.). For example, although the permanent employment contracts with forestry workers can be seen as a non-financial type of compensation in terms of the duration of the work relationship and the employee's business security, this form of employment also means monetary payments to the worker, and therefore should be seen within the scope of financial compensation. The same is important for the later elaboration of certain strategic directions for workforce sustainability.

The top-ranked factors for stronger recruitment of forestry workers are: (1) *Job stability and regular income*, (2) *Higher regular wages and guaranteed increase with years of service*, and (3) *Workers' social rights (insurance policies, annual leave, rewards, etc.)*. They are followed by (4) *Benefit service (early retirement)*, and (5) *Competitive (attractive) starting salary*. *Interesting working environment and colleagues* (14), *Working in nature in open space and fresh air* (15) and *Interesting and challenging work* (16) were rated as the least influential factors. It should be noted that the first five elements refer to financial forms of compensation, whether direct or indirect.

Table 1 Ranking of factors for stronger recruitment of forestry workers

Rank	Factor	%	C
1.	Job stability and regular income	91.8	F
2.	Higher regular wages and guaranteed increase with years of service	90.0	F
3.	Social rights (insurance policies, annual leave, rewards, etc.)	88.0	F
4.	Benefit service (early retirement)	86.5	F
5.	Competitive starting salary	86.1	F
6.	Care for health and safety at work	82.2	N
7.	State incentives for new employments	76.7	N
8.	Company's reputation as a good employer	70.9	N
9.	Accommodation, meals and transport to work	69.8	N
10.	Mentorship for young workers	63.8	N
11.	Presence of a unique training center for forestry workers	62.3	N
12.	Image of forestry profession and occupation	58.2	N
13.	Possibility of learning and developing new skills	52.0	N
14.	Interesting work environment and colleagues	48.1	N
15.	Working in nature in open space and fresh air	45.6	N
16.	Interesting and challenging work	42.4	N

3.1.2 Factors for Stronger Retention of Forestry Workers

Elements of successful retention are focused on improving relations between workers (employees) and employers. The goal is in fulfilling the employees' needs and increasing their satisfaction with job and workplace. Table 2 presents the results of the evaluation and the established ranks of the observed factors for successful worker retention in forestry.

The best rated factors for the successful retention of forestry workers are: (1) *Workers rewards and satisfactory salary*, (2) *Salary in line with work results*, and (3) *Permanent employment contracts*. They are followed by (4) *Adequate social rights, benefits and safety at work*, and (5) *Possibility of promotion and a raise with clear future development plan*. At the bottom of the scale are: *Employee participation in making important company decisions* (16), *Possibility of taking interest-free loans from the employer* (17), and *Enabling work over the age of 65* (18). Similar as the factors for stronger recruitment, the best ranked factors for successful retention of forestry workers are in financial forms of compensation (factors 1–2 – direct financial compensation; factors 3–5 – indirect financial compensation).

Table 2 Ranking of factors for stronger retention of forestry workers

Rank	Factor	%	C
1.	Worker rewards and satisfactory salary	93.7	F
2.	Salary in line with work results	92.6	F
3.	Permanent employment contract	91.4	F
4.	Adequate social rights, benefits and safety at work	88.1	F
5.	Possibility of promotion and raise with clear future development plan	82.7	F
6.	Managers' understanding of employee motivation	76.1	N
7.	Established work, i.e. »established teams« on worksite	74.6	N
8.	Constant employer care about the workers' health	74.6	N
9.	Satisfaction with the management, managers and employees	74.3	N
10.	Collegial relationship, open dialogue and communication	72.7	N
11.	Satisfaction with company policies and decisions	72.4	N
12.	Balance of private and business life	66.3	N
13.	Flexible working hours	65.9	N
14.	Constant improvement of worker skills	64.3	N
15.	Low work-related stress	63.2	N
16.	Employee participation in making important company decisions	61.4	N
17.	Possibility of taking interest-free loans from employer	60.2	N
18.	Enabling work over the age of 65	27.8	F

3.1.3 Factors for Higher Work Commitment of Forestry Workers

Upgrading work commitment is oriented towards greater use of human capital in the organization. It includes arranging both financial and non-financial compensations with constant promotion of employee-employer relations. Determined rankings of factors for ensuring greater commitment of workers are presented in Table 3. In this case, the indicators of financial or non-financial compensation are not specifically shown, since the focus is on the management of the company and not on the workers.

The following factors were identified as the most important: (1) *Consistent and transparent salary criteria*, (2) *Clear job and task description*, (3) *Good cooperation and relationships within the company*, (4) *High level of work organization in the company*, and (5) *Monitoring workers' performance and progress*. Other factors, although ranked lower, also have a relatively high proportion

Table 3 Ranking of factors for higher work commitment

Rank	Factor	%
1.	Consistent and transparent salary criteria	81.7
2.	Clear job and task description	81.0
3.	Good cooperation and relationships within the company	78.6
4.	High level of work organization in the company	78.2
5.	Monitoring workers' performance and progress	78.1
6.	Respect received from superiors and colleagues	78.0
7.	Management's interest in the welfare of employees	74.9
8.	Highlighting the worker merits and encouraging excellence	74.5
9.	Encouraging and appreciating workers' deliberations	71.9
10.	Willingness to work for the benefit of the company	71.6
11.	Delegating authority and responsibility for operational tasks	67.6
12.	Good cooperation with other companies, partners and clients	65.5
13.	Possibility of employee education and development	56.9

of the Likert ratings 4 and 5 and, accordingly, they should also be given some relevance when creating workforce sustainability strategies. The same applies to the factors for stronger recruitment and successful retention of workers in forestry.

3.2 Strategic Directions for Improving Workforce Sustainability in Forestry

When creating and designing strategic directions for improving workforce sustainability, together with the research of sustainability factors, the following documents were consulted: Development Strategy of FB&H (GFBH 2020), Strategy for the Development of Wood Industry in FB&H (CEFBH 2018), Forestry Program of FB&H (FMAWMF 2017), Law on Development Planning and Development Management in FB&H (GFBH 2017), and Manual for the Preparation of Strategic Documents in FB&H (FIDP 2021), which served as the basic guideline in the development of the present strategic directions. It should be emphasized that, due to the characteristics of the paper as a scientific work, the creation of the given directions did not follow the formal procedure and methodology for creating strategic documents. Therefore, defined strategic orientations can only conditionally be called »strategies« because they represent possible approaches or orientations within an overall strategic goal. For the same reason, the structure of sustainability »strategies« developed in this paper deviates from the usual or standard minimal structure of official strategic documents.

The starting point in creating these strategies was the strategic focusing, which determines strategic orientations or key tendencies of the strategy, most often as prospective competitive advantages or as the most critical problems that require strategic interventions. The following was set as the main strategic challenge in the presented research:

– »How to ensure sufficient numbers of professionally trained and high-quality workforce in FB&H forestry?«

Strategic goals were derived from the set strategic focus. This includes the process of »extracting« strategic goals from previously determined strategic focuses, and consideration of strategic documents of higher level (Forestry Program of FB&H, Development Strategy of FB&H). The defined strategic goal should clearly reflect previously established development needs, it should be achievable within the given time period and measurable by using objective indicators. The strategic goal in this paper was defined as:

– »Establishment of a sustainable workforce in forestry«

To achieve the defined strategic goal, it is necessary to understand the most significant factors that need to be acted upon in order to initiate the desired socio-economic changes. Therefore, (1) priorities, as key fields and courses of action, and (2) measures, as more precise directions for easier planning of specific activities, are determined.

Within the defined strategic goal, the following priorities were set in the research:

1. Increase interest in the job of forestry worker
2. Retain the existing quality forestry workers in forestry companies
3. Increase the motivation and commitment of workers to forestry work
4. Reduce the demand/need for forestry workers (in the context of shortage of workers on the market).

Although priorities 1 and 4 seem to be in conflict, the increase in the interest of young people in forestry work can be positively correlated with the increase of mechanization in wood harvesting (presumably operating modern machinery can be significantly more attractive than heavy manual labor), which at the same time, due to high productivity, reduces the need for a large number of workers.

After determining the priorities, the strategic measures and activities are determined. Measures represent sets of related substantive elements within a specific area of planned strategic intervention. They guide future planners to design specific projects and activi-

ties more easily, creatively and effectively. By developing priorities into measures, we try to determine specific areas of action which imply a set of targeted and related interventions, most often in the form of desired activities and projects that must be undertaken. So, within each measure, activities are determined as specific steps that fulfill a certain measure or priority. Their main stakeholders, financial structure and implementation period are additionally determined for them. The proposed measures and activities of the established strategic orientations are shown in Tables 4–7.

Further to the above, 4 strategic directions were defined: (1) Direct financial strategy, which emphasizes direct monetary payments to workers and is oriented towards labor productivity, (2) Indirect financial strategy, which focuses more on providing indirect material gains to workers and the quality of the work done, (3) Educational strategy, aimed at the education and training of workers, and (4) Technical-technological strategy, aimed at increasing the mechanization in forest operations thus reducing the demand for labor. It should be noted that strategies 3 and 4 also include financial compensation for work, but unlike strategies 1 and 2, they are more focused on elements of non-financial compensation. In this sense, different strategies regarding the form of compensation are only a guideline with the purpose of a comprehensive approach to the problem at hand. Each of the defined strategies is briefly described in the following chapters, and a complete presentation of the defined strategic directions is given in Tables 4 to 7.

3.2.1 Strategic Direction I – Direct Financial Strategy

Direct financial strategy primarily implies straightforward financial motivation and attraction of workers by increasing their income through direct monetary payments. The main strategic measures include the growth of the starting (initial) and regular wages and their increase with years of service. The strategic direction is oriented towards labor productivity, since monetary payments are connected to the achieved results of the worker. Workers' incomes are not limited and their significant increase is possible, since salary payments would be made out in line with the work performance, i.e. realized work effects without limitations. Fulfillment of the defined minimum work performance signifies the prerequisite or the starting point for the calculation of achieved work results, but represents the level that is not sufficient for workers in terms of fulfilling their needs (desire) for money and income (it stimulates workers to achieve greater work results, hence greater income). Creation and application

of a unified system of performance standards for forestry workers, and unified system of salary calculations, are considered necessary for the application of this strategy, especially regarding complex managing structure of the FB&H forests (numerous administration, forestry companies, authorities, etc.). In addition to the above, the strategy should also strive to establish such procedures that will contribute to motivating and attracting employees by means of clearly defined reward criteria, emphasizing merit, progress and promotion, all with the sole aim of enabling workers to get increased income, i.e. higher direct monetary payments (Table 4).

3.2.2 Strategic Direction II – Indirect Financial Strategy

This strategic orientation focuses on the improvement of financial compensation for work by increasing the indirect material gains of workers, i.e. those which contribute to raising the material standard of employees, but are not received in salary or in the form of money. Unlike the previous, this strategy puts emphasis on increased care for workers, worker satisfaction and the quality of their work. It includes the implementation of a series of activities related to regular payments of pension, health, life and other worker insurances (mandatory and additional), appropriate working hours, introduction or increase of benefit service, increasing the quality of accommodation, food, transport, equipment for workers, greater involvement of workers and their representatives in the organization, etc. (Table 5). The purpose of such activities is to ensure and improve stable, balanced and appropriate working conditions, and adequate care for employees, while strengthening the protection of workers and respecting all their rights. Given that the indirect material gains of workers as the basis of this direction do not depend on the achieved work results, the strategy foresees payment of work according to time, i.e. according to the realized working hours (daily wage). However, achieving the prescribed minimum work norm is set as a condition for achieving the right to a daily wage. Defining the minimum working rate would further require a comprehensive time study research and agreement of all parties involved.

3.2.3 Strategic Direction III – Educational Strategy

The educational strategy is aimed at training and improving the skills of workers. The accent is on continuous training and education of workers as well as their employers, on raising public awareness of the issues and various aspects of forestry work and forestry profession, with efforts put into the popularization of the forestry profession (Table 6). It focuses on

Table 4 Strategic direction I – Direct financial strategy

Priority	Measure	Activity	Stakeholders	Responsible body	Estimated costs	Estimated period
Increasing interest in the job of forestry worker (recruiting new, young workers)	Increase the starting wages of forestry workers	Legally determine the minimum wages for loggers, tractor operators, assistant workers, choke setters, etc. (in accordance with the difficulty and demands of the work)	Government of FB&H + Parliament Relevant FB&H ministry + relevant county ministries	Government of FB&H	Amount: 15,000,000 € Source: 50% employers (through increasing the prices of services and forestry products) 25% FB&H budget 25% counties' budget	3 years
		Provide additional dedicated funds to increase the initial minimum wages of forestry workers (in accordance with the difficulty and demands of the work)	Government of FB&H + Parliament Relevant FB&H ministry + relevant county ministries Public forestry companies Forestry contractors	Government of FB&H		2 years
		Elaborate and provide additional tax relief for workers' salaries of (tax credits, subsidies, etc.)	Government of FB&H + County Governments	Government of FB&H		3 years
Retaining employed workers in forestry companies	Payment of workers' wages according to the achieved work results	Design uniform performance standards for forestry workers (for the entire FB&H)	Relevant government/county ministries, Forestry faculty Employers (public/private forestry companies) Forestry workers	Forestry faculty	Amount: 2,500,000 € Source: 50% FB&H budget 50% counties' budget	2 years
		Monitor the work performance of forestry workers	Employers (public/private forestry companies) Forestry workers	Forestry companies		3 years
		Create a uniform payroll system (for the entire FB&H)	Relevant government/county ministries Public forestry companies Forestry contractors Forestry union Professional associations Economic (or engineering) chamber	Relevant FB&H ministry		3 years
		Ensure regular payment of wages in time intervals defined by the employment contract	Employers (public/private forestry companies) Forestry workers Competent inspection bodies	Forestry companies		1 year
		Define a system/coefficients for increasing the basic salary according to years of service. Increase the basic workers salary	Relevant FB&H ministry + relevant county ministries Employers (public/private forestry companies)	Relevant FB&H ministry		4 years
Increasing the motivation and commitment of forestry workers	Improve the working environment within the employer organization	In addition to the existing ones, consider other possible benefits and bonuses in the workers' payments with regard to years of service	Government of FB&H Relevant FB&H ministries + relevant county ministries	Government of FB&H	Amount: 20,000,000 € Source: 50% employers (through increasing the prices of services and forestry products) 25% FB&H budget 25% counties' budget	3 years
		Design a system enabling worker promotion in the organization, and thereby increase of wages	Employers (public/private forestry companies) Forestry workers	Forestry companies		3 years
		Establish consistent, transparent and fair criteria for rewarding workers (annual rewards for work results, jubilee awards, etc.)	Employers (public/private forestry companies) Forestry workers Educational institutions	Forestry companies		3 years
		Create a plan of giving merits to workers with public awarding of cash bonuses, gift vouchers, etc., for outstanding work, respecting work safety, etc.	Employers (public/private forestry companies) Forestry workers Educational institutions	Forestry companies	Amount: 2,500,000 € Source: employers	3 years
				Total:	40,000,000 €	4 years

Table 5 Strategic direction II – Indirect financial strategy

Priority	Measure	Activity	Stakeholders	Responsible body	Estimated costs	Estimated period
Increasing interest in the job of forestry worker (recruiting new, young workers)	Promote workers' social rights	Ensure regular payments for workers' pension and health insurance, related social services and rights, paid leave, vacations, etc.	Relevant inspection bodies Employers (public/private forestry companies) Forestry workers	Forestry companies	Amount: 10,000,000 € Source: 30% FB&H budget 50% Counties' budget 20% Forestry companies	2 years
		Define and respect working hours with payment of regular and overtime hours	Employers (public/private forestry companies) Forestry workers	Forestry companies		2 years
		Provide adequate transportation, accommodation and meals, or appropriate financial compensation	Employers (public/private forestry companies)	Forestry companies		2 years
		Increase the scope benefit service to legal maximum	Relevant FB&H ministry + relevant county ministries	Relevant FB&H ministry		2 years
		Subsidize allocations from salaries for health and pension insurance	Relevant FB&H ministry + relevant county ministries	Relevant FB&H ministry		2 years
		Offer permanent employment contracts	Employers (public/private forestry companies) Forestry workers	Forestry companies		2 years
Retaining employed workers in forestry companies	Ensure balanced, stable and adequate working conditions	Respect all workers' rights in accordance with applicable regulations	Relevant inspection bodies Employers (public/private forestry companies)	Forestry companies	Amount: 2,500,000 € Source: Forestry companies	1 year
		Ensure the application of measures and instruments of health protection and safety at work (protective equipment, medical examinations, etc.)	Relevant inspection bodies Employers (public/private forestry companies)	Forestry companies		1 year
		Increase the quality of accommodation, meals and transport to work	Employers (public/private forestry companies)	Forestry companies		2 years
		Provide a clear description of the job and tasks for each worker/workplace	Employers (public/private forestry companies)	Forestry companies		2 years
Increasing the motivation and commitment of forestry workers	Increase the level of work organization in forestry companies	Establish working groups and teams, form of work organization, etc.	Forestry faculty Employers (public/private forestry companies) Forestry workers	Forestry companies	Amount: 1,500,000 € Source: Forestry companies	2 years
		Define procedures, competencies, responsibilities, control instruments, etc.	Employers (public/private forestry companies)	Forestry companies		2 years
		Ensure a higher level of internal and external communication and coordination	Employers (public/private forestry companies) Forestry workers	Forestry companies		2 years
		Provide courses and workshops for acquiring additional business/managerial skills, abilities and knowledge for managers	Forestry faculty Private management training agencies Employers (production managers in public and private forestry companies)	Forestry faculty		3 years
		Ensure workers' participation in decision-making and enable free expression of their views and opinions	Employers (public/private forestry companies) Forestry workers	Forestry companies		2 years
		Establish professional associations in forestry (employers, workers, etc.) and enable joining in workers' unions	Employers (public/private forestry companies) Forestry workers	Forestry companies Forestry workers		3 years
	Total:				17,500,000 €	3 years

Table 6 Strategic direction III – Educational strategy

Priority	Measure	Activity	Stakeholders	Responsible body	Estimated costs	Estimated period
Increasing interest in the job of forestry worker (recruiting new, young workers)	Promote forestry workers' occupation (through increased level of health protection, safety at work, etc.)	Ensure work with a mentor (experienced worker) for young/new workers (loggers, tractor operators)	Employers (public/private forestry companies) Forestry workers	Forestry companies	Amount: 25,000,000 € Source: 35% FB&H budget 35% Counties' budget 30% EU funds	2 years
		Provide a plan and program for continuous training of workers and managers in the field of safety and health and ensure their regular implementation	Forestry faculty Employers (public/private forestry companies) Forestry workers	Forestry faculty		4 years
	Promote forestry profession and forestry workers' occupation in the public by means of mass media (internet, daily newspapers, radio, television, etc.)	Establish a training center for forestry workers	Relevant FB&H ministry Public forestry companies Forestry workers	Relevant FB&H ministry		3 years
		Establish a training center for forestry workers	Relevant FB&H ministry Forestry faculty	Government of FB&H		5 years
Retaining employed workers in forestry companies	Continuous improvement of the knowledge, skills and abilities of managers, foremen and forestry workers	Enable advancement within the company in accordance with the level of employee training	Employers (public/private forestry companies) Forestry workers	Forestry companies	Amount: 2,500,000 € Source: 30% FB&H budget 50% Counties' budget 20% Forestry companies	3 years
		Provide a plan and program for continuous training of managers/executives in the field of human resources management	Employers (public/private forestry companies) Educational institutions (human resource management) Forestry workers	Educational institutions		4 years
Increasing the motivation and commitment of forestry workers	Constant care for the education, safety and health of forestry workers	Ensure equal opportunities for education and development for all workers	Employers (public/private forestry companies)	Forestry companies	27,500,000 €	3 years
		Ensure regular systematic health examinations for all forestry workers	Employers (public/private forestry companies)	Forestry companies		3 years
Total:				Total:		5 years

the promotion of the forestry worker occupation and forestry profession through education, i.e. provision of the continuous improvement of knowledge, abilities and skills with a special emphasis on increasing the level of safety and health at work. For example, as strategic measures, it includes the introduction of young workers to work by assigning them an experienced mentor-worker, continuous training for managers in acquiring the necessary managerial skills (especially in the area of human resources management), providing equal opportunities for education and development to all workers. The establishment of a specialized Training Center for the forestry workers is the main infrastructural assumption of this strategic orientation.

3.2.4 Strategic Direction IV – Technical-technological Strategy

The last strategic direction is aimed at increasing the level of mechanization in forestry operations (esp. wood harvesting) in order to reduce the demand, i.e. the need for a numerous workforce in forestry. It presupposes stronger mechanization of forestry work and the introduction of modern, highly efficient technologies in the forestry production. This, replaces manual and motor-manual labor with the application of mechanized wood harvesting to a greater extent, and consequently reduces the need for forestry workers (loggers, tractor operators, assistant workers, choke setters, etc.) (Table 7). Strategic orientation would require an elaborate study and plan for the introduction and adaptation of mechanical wood harvesting to the existing methods and conditions of forest management in FB&H, ensure subsidies for the purchase of machines, develop appropriate educational programs and operator training, design a system of work norms and worker

Table 7 Strategic direction IV – Technical-technological strategy

Priority	Measure	Activity	Stakeholders	Responsible body	Estimated costs	Estimated period
Reducing the need for numerous labor force in forestry (loggers, tractor operators, choke setters, assistant workers, etc.)	Introduce mechanized wood harvesting (harvesters, forwarders)	Design a study, plan and recommendations for the introduction and adaptation of mechanized wood harvesting to the existing methods and conditions of forest management	Relevant FB&H ministry + relevant county Forestry faculty Public forestry companies	Public forestry companies	Amount: 25,000,000 € Source: 30% FB&H budget 50% Counties' budget 20% Forestry companies	5 years
		Provide subsidies and incentives for the purchase of modern machines (harvesters, forwarders, etc.)	Relevant FB&H ministry + relevant county ministries	Relevant FB&H ministry		5 years
		Provide adequate training for machine operators and worksite managers	Licensed personnel for providing specialized training in working with harvesters and forwarders	Licensed training agencies		3 years
		Design a system of performance standards and criteria for paying workers	Forestry faculty Public forestry companies	Forestry faculty		3 years
Increasing interest in the job of forestry worker (recruiting new, young workers)	Increase the reputation of forestry workers (machine operators) in society	Promote new highly qualified jobs (harvester/forwarder operator, etc.)	Relevant FB&H ministry + relevant county Public forestry companies	Relevant FB&H ministry	Amount: 5,000,000 € Source: 30% FB&H budget 40% Counties' budget 30% EU funds	4 years
		Provide a higher starting salary in accordance with the requirements and responsibilities of the workplace	Relevant FB&H ministry + relevant county ministries Public and private forestry companies	Forestry companies		3 years
Retaining employed workers in forestry companies	Enable handling of new and modern equipment and technology	Provide subsidies and incentives for replacing old work equipment with the new one (safety equipment, chainsaws and tools, tractors, other machines, etc.)	Relevant FB&H ministry + relevant county ministries	Relevant FB&H ministry	Amount: 5,000,000 € Source: 30% FB&H budget 40% Counties' budget 30% EU funds	5 years
		Use modern IT equipment (GPS communication in the organization of the worksite, integrated systems for monitoring effects, etc.)	Public and private forestry companies Forestry workers	Forestry companies		6 years
Increasing the motivation and commitment of forestry workers	Simplify of everyday work tasks Involve machine operators in planning	Ensure the participation of machine operators in making plans and decisions, innovations, etc.	Public and private forestry companies Forestry workers	Forestry companies	Amount: 2,500,000 € Source: 30% FB&H budget 40% Counties' budget 30% EU funds	6 years
				Forestry companies		6 years
			Total:	Total:	37,500,000 €	6 years

payment criteria, etc. In addition to reducing needs for production workers, the strategy focuses on the promotion of new (more attractive) workplaces of modern forest machinery operators, subsidies and credit lines for replacing old machines and equipment with the new ones, encouraging the use of modern IT equipment and solutions in the organization, execution and monitoring of forestry operations. The same also implies more significant inclusion of employees in customized and targeted educational programs (training courses), but also stronger participation of machine operators in planning and decision-making regarding wood harvesting.

4. Discussion and Conclusions

The Development Strategy of FB&H for the period 2021–2027 (GFBH 2020) foresees the creation of conditions for the workforce availability on the labor market, by ensuring the requirements for retaining and strengthening the capacities of the existing staff and the unemployed by means of retraining programs for deficit occupations, dual education, networking and promotion of industries with a shortage of labor force, as well as improving the legal framework for volunteering, self-employment and development of entrepreneurial skills. It is also envisaged to develop and implement an efficient employment policy that foresees the provision of funds for quick training with employers who have expressed an interest in a specific workforce profile.

In the Forestry Program of FB&H (FMAWMF 2017), which actually represents a strategy for the development of forestry in FB&H, the deficiencies in the current way of planning the education of personnel in the forestry profession are emphasized, as well as the necessity of applying different methodological approaches in the creation of personnel and educational policies in FB&H forestry. Modernization and standardization of technologies and means of work in forestry is also mentioned as a strategic goal, with a special emphasis on creating a technological classification of forests as well as legal prerequisites for the establishment of an efficient and functional occupational health and safety service in all economic entities that operate in forest exploitation.

Recent studies of the position and status of the labor force in FB&H forestry have shown that the shortage of forestry workers has been a significant problem for a longer time, with a pronounced tendency for its further deterioration in the future, and a whole series of unfavorable factors that affect such a situation (emigration of rural population, departure of work-aged

population to other countries, unfavorable demographic trends, poor age structure of forestry workers, lack of interest among young people in forestry work, inadequate training system, bad image of forestry, low cost of labor, etc. (Mijoč 2022, Šporčić et al. 2023, 2024). The research also pointed out that there is no official strategy or systematic approach to solving the problem of forestry workers shortage and improving the workforce sustainability in FB&H forestry (Mijoč 2022).

For this reasons, based on the examination of the main factors for stronger recruitment, retention and commitment of forestry workers, as well as the study of available strategic documents and good practice examples, four potential strategic approaches aimed at improving the sustainability of the workforce in FB&H forestry were created. Due to the specificities of a scientific paper and the applied research methods, the created strategic approaches can only conditionally be called »strategies«. In fact, they represent possible directions of action within the same strategic goal and should not be interpreted as legal and legitimate documents when solving the issue of workforce sustainability in the FB&H forestry. Their contribution consists in an innovative methodological design and, of course, in practice they can certainly serve as an auxiliary tool or as a kind of background when defining strategic goals, i.e. strategic documents. Therefore, it is understandable that the very structure and approach to creating the »strategies« presented in this paper deviates from the prescribed minimum structure of official strategic documents in FB&H. During the formal adoption of strategic documents, it will be mandatory to carry out the necessary administrative and technical preparatory work beforehand, which implies the initiation of the decision-making process on creation of a strategic document, which should define included stakeholders, responsible bodies and authorities, methods for forming work groups and coordination, deadlines for preparation and reporting on the adoption process as well as the financial resources needed for the creation of such a strategic document.

The main elements of the forestry workforce sustainability were observed through the factors of stronger recruitment and retention of workers and greater commitment to work. The most significant factors of successful attraction and retention of workers were those related to the financial compensation (e.g. »*Job stability and regular income*« and »*Higher regular wages and guaranteed increase with years of service*« for stronger recruitment; »*Worker rewards and satisfactory salary*« and »*Salary in line with work results*« for stronger

retention; or »*Consistent and transparent salary criteria*« for greater work commitment). The factors of direct and indirect financial compensation are equally represented, although it seems that direct financial factors are somewhat better ranked in case of employee retention, but not enough to draw definitive conclusions. Although direct and indirect monetary payments are equally important, because they determine the total amount of material gains and provide social rights of workers, it is necessary to separate them when developing strategic directions in order to clearly see certain differences, i.e. their advantages or disadvantages. For example, approach that favors direct compensation, places emphasis on productivity or work efficiency, while emphasized indirect compensation focuses more on the quality of the work performed. By considering such options, when elaborating a strategic goal within the overall strategy, it is possible to give priority to one or the other. Also, better ratings and a higher ranking of financial compensation in no case means that other, non-financial factors should be ignored. On the contrary, it is certainly necessary to consider other possible strategic alternatives where the emphasis would be on non-financial worker compensation in order to make the approach to the sustainability of the workforce in forestry as complete as possible.

Based on the research conducted, four possible strategic orientations were defined: (1) Direct financial strategy, which emphasizes direct monetary payments and is oriented towards labor productivity; (2) Indirect financial strategy, which focuses on indirect material gains of workers and the quality of performed work; (3) Educational strategy, aimed at the education and training of workers; and (4) Technical-technological strategy, aimed at increasing the mechanization in wood harvesting. For each individual strategy, priorities, their measures and activities, stakeholders and responsible bodies, as well as estimated costs and period of implementation are defined (Tables 4–7). While the Direct and Indirect financial strategies are opposed in terms of productivity and quality of work, the Educational and Technical-technological strategies tend more towards the balance of these two concepts and complement each other, especially in terms of improving the abilities and skills of workers. The described strategies actually represent possible strategic orientations in setting a unique strategic goal of workforce sustainability in forestry, which reflects the practical contribution of this research. A unique strategic goal can include something from each strategic direction, depending on the assessment of the relevant stakeholders when developing the strategy in practice,

while taking into account objective possibilities, real circumstances and other important elements. In addition, one of the important steps that should also be carried out in this process is an adequate assessment, i.e. evaluation of the developed strategic directions.

Strategic orientations related to such elements of labor shortage that are of more global nature and without exclusive domain within forestry sector (demographic trends, aging of population, migrations, depopulation of rural areas, low birth rate, etc.) were not considered as possible strategic approaches due to the complexity of their elaboration (intersectoral problem) and the breadth of the topic (global migrations, political moments, etc.), which is why it was very difficult to elaborate them in one paper. For this reason, for example, the strategy of importing foreign labor force into FB&H was not considered as a separate strategic option.

The Master Plan of Forestry Infrastructure in FB&H (FMAWMF 2019) states that one of the reliable ways to attract and retain workers, and also increase their motivation, certainly lies in increasing the price of labor. It is unquestionable that a regular and decent salary in accordance with the difficulty of work is the basic assumption of the stability in any employment relationship. Therefore, the development of an appropriate and quality system of work evaluation and worker rewards should be considered as a prerequisite for the sustainability of the forestry workforce. The same also includes the establishment of a proper motivation management system, where it is necessary to identify the common motives of workers, which includes listening and understanding the employees who are different in terms of age, function, opinions, attitudes, etc. Discovering the motives of individuals, and knowing their common goals in the organization, is the key element for the implementation of certain strategies of material and non-material rewarding of workers. The results of the present research showed that the greatest importance, considering the form of remuneration of forestry workers, is given to financial factors (higher salary, salary in line with work results, guaranteed salary increase with years of service, etc.). However, a simple linear increase in wages is not enough to achieve the desired results, i.e. to ensure the sustainability of the workforce in the long term. This must be done in accordance with certain compensation strategies, which aim to build an efficient and competitive forestry sector, i.e. companies, by exploiting the full potential of its employees. Such strategies must be (1) effective, which is reflected through work performance, quality, worker satisfaction and labor costs, then (2) fair, which implies an honest approach

to all employees, by recognizing their contribution (higher pay for better work, experience or training) and their needs (fair compensation and procedures), and finally (3) harmonized, which means application within different legal and other juristic regulations (Buble and Bakotić 2013). The application of such strategies implies a good knowledge of compensation management, i.e. the correct valuation of jobs with the construction of scoring systems and the formation of basic salaries, and then the determination of the incentive part of the salary, allowances, compensations and benefits based on work results and work performance.

In addition to extremely important financial elements, non-financial factors of workforce sustainability can also be very important for the appeal of the occupation. Among the highly rated factors are health care, job security, work safety, company reputation, sector image, workers' accommodation, meals and transport, clear description of work and tasks, good cooperation and relations within the organization, etc. However, the forestry workers' job is currently far from popular, and considerable efforts are necessary to make the forestry sector competitive on the labor market. Musić et al. (2013) thus emphasize the importance of continuous activities on raising awareness about the importance of forestry and wood industry for the sustainable development of FB&H through promotion in schools, media, associations, etc. Improved promotion of the sector, first by education and then through other relevant systems, together with well-organized forestry profession, will contribute to a better image of forestry, and thus to a more successful recruiting of young workers (Tsioras 2010). Convincing young people to get involved in forestry operations is of prime importance not only for forestry but also for complete rural development (Roca 1998). UNECE/FAO (2021) conclude that in the coming period it is extremely important to increase the awareness of all jobs in forestry, with the aim of ensuring both a stronger attraction and greater resilience and flexibility of qualified labor.

The Master Plan of Forestry Infrastructure in FB&H (FMAWMF 2019) also provides the adoption of regulations on the scope of measures for the restoration and maintenance of forest order, which would legally enable the mechanized ways of wood harvesting (use of harvesters and forwarders). Reducing the demand, that is, the need for a great number of forestry workers can be achieved by using mechanized logging. However, this requires highly qualified harvester and forwarder operators, who are pretty valued employees on the European labor market. The successful implementation of mechanized logging in the existing forest

management system, i.e. the replacement of semi-mechanized with a fully-mechanized wood harvesting (or combination of the two), implies a significant reorganization of forestry work, expected resistance to changes, research and development of adaptable ways and methods of wood extraction, as well as provision of a sufficient number qualified workers. This requires exceptional efforts, top management and expertise, and significant financial resources. If the mechanization of logging in the FB&H is left uncontrollable, as a necessity of private contractors (due to the lack of workers, but also the increase in productivity and earnings), without prior and timely preparations of the responsible stakeholders (authorities, public companies, etc.) negative consequences for forests and forest land might be immense. Therefore, the application of mechanized logging must be planned in time, adapting the new way of operating to the existing management system, including the extensive and thorough work of forestry scientists and experts. It is considered that public forestry companies must continue to perform a certain part of forestry operations with their own capacities, i.e. retain their own labor resources (harvesters and forwarders) and qualified workers.

In addition to all of the above, the problem of the lack of forestry workers in FB&H is clearly under the significant influence of external factors that are not specific only to forestry (unfavorable demographic trends, economic situation, migrations, etc.). This puts forestry in an additionally disadvantageous position, considering that the forestry worker job falls into the group of difficult and undesirable occupations. However, the forestry sector must not remain indifferent to this issue, shifting the responsibility to higher or other instances and other stakeholders. On the contrary, it must adapt its policies and activities to global processes that consequently affect the workforce, especially with regard to demographic and other trends such as the development of new skills and technologies, the establishment of flexible organizational structures, reorganization of work, adaptable employment forms, etc. (UNECE/FAO 2020).

Finally, strategy in the broadest sense implies certain actions directed towards the achievement of set goals. In the context of this research, the strategy represents a proposal of activities and measures necessary for achieving a stable and sustainable workforce in forestry. The term strategy refers exclusively to strategic action or orientation, that is, strategic direction as a kind of roadmap or guiding thread that can be useful when creating real strategic documents. The 'strategy' of the forestry workforce sustainability should repre-

sent just one of the important strategic goals when creating a comprehensive forestry development strategy.

The main challenge of designing a workforce sustainability strategy, in general, is that it is an extremely complex and extensive issue, focused at workforce, capital and potential. How to manage this capital in the future, how to use its potential and improve its abilities, i.e. how to attract new workers to a rather undesirable occupation and ensure the long-term stability of the forestry workforce, i.e. forestry production, are the questions that inevitably require a systematic approach and urgent involvement of all relevant stakeholders, placing this issue in the context of strategy or strategic action. Different approaches without a clear vision and goal would not result in the adoption of adequate priorities, measures and activities necessary to overcome this problem.

5. References

- Adams, G., Armstrong, H., Cosman, M., 2014: Independent forestry safety review – An agenda for change in the forestry sector. Final report – Summary of recommendations, 12 p.
- Arman, Z., Nikooy, M., Tsiaras, P., Heidari, M., Majnounian, B., 2022: Mental workload, occupational fatigue and musculoskeletal disorders of forestry professionals: The case of a Loblolly plantation in Northern Iran. *Croatian Journal of Forest Engineering* 43(2): 403–424. <https://doi.org/10.5552/crojfe.2022.1639>
- Bernasconi, A., Schroff, U., 2011: Professions and training in Forestry. Results of an inquiry in Europe and northern America. Federal Office for the Environment, Bern, 84 p.
- Bluszkowska, U., Nurek, T., 2014: Effect of mechanization level on manpower needs. *Folia Forestalia Polonica, series A* 56(4): 194–201. <https://doi.org/10.2478/ffp-2014-0022>
- Bovenzi, M., 2008: A follow up study of vascular disorders in vibration-exposed forestry workers. *International Archives of Occupational and Environmental Health* 81: 401–408. <https://doi.org/10.1007/s00420-007-0225-9>
- Buble, M., Bakotić, D., 2013: Kompenzacijski menadžment (*Compensation management*). Sveučilište u Splitu, Ekonomski fakultet, 312 p.
- Cacot, E., Grulois, S., Thivolle-Cazat, A., Magaud, P., 2015: Mechanization of French logging operations: challenges and prospects in 2020. Proceedings of the 48th FORMEC Symposium, October 4–8, Linz, Austria, 23–30.
- Camargo, D.A., Munis, R.A., Batistela, G.C., Simões, D., 2022: Exposure to occupational noise: machine operators of full tree system in Brazil. *Croatian Journal of Forest Engineering* 43(2): 391–402. <https://doi.org/10.5552/crojfe.2022.1437>
- CEFBH – Chamber of Economy of Federation of Bosnia and Herzegovina, 2018: Strategija razvoja drvne industrije Federacije Bosne i Hercegovine za period 2016–2025 (*Strategy for the development of the wood industry of the Federation of Bosnia and Herzegovina for the period 2016–2025*). Sarajevo, Bosnia and Herzegovina, 56 p.
- Efthymiou, P.N., 2008: Wood Harvesting. Aristotle University of Thessaloniki, Thessaloniki.
- Egan, A., Taggart, D., 2004: Who will log? Occupational choice and prestige in northern New England. *Journal of Forestry* 102(1): 401–406.
- EU-OSHA, 2008: E-fact 29 – Occupational safety and health in Europe's forestry industry. European agency for safety and health at work, 1–13 p.
- Eurostat 2024a: Fatal Accidents at work by NACE Rev. 2 activity. https://ec.europa.eu/eurostat/databrowser/view/HSW_N2_02/default/table?lang=en
- Eurostat 2024b: Non-fatal accidents at work by NACE Rev. 2 activity and sex. https://ec.europa.eu/eurostat/databrowser/view/hsw_n2_01__custom_12140580/default/table?lang=en
- FAO/ILO/UN, 2023: Occupational safety and health in the future of forestry work. Food and Agriculture Organization of the United Nations (FAO), International Labour Organization (ILO) and United Nations. Forestry Working Paper, No. 37, Rome, 54 p. <https://doi.org/10.4060/cc6723en>
- FIDP – Federal Institute for Development Programming, 2021: Izrada strateških dokumenata u Federaciji BiH – Priručnik za praktičare javnog sektora (Manual for the preparation of strategic documents in FB&H). Sarajevo, Bosnia and Herzegovina, 106 p.
- FMAWMF – Federal Ministry of Agriculture, Watter Management and Forestry, 2021: Information on forest management in the Federation of Bosnia and Herzegovina in 2020 and management plans for 2021. Sarajevo, Bosnia and Herzegovina, 74 p. Available online: <https://fmpvs.gov.ba/informacije-o-gospodarenju-sumama/> (accessed on 11 September 2022).
- FMAWMF – Federal Ministry of Agriculture, Watter Management and Forestry, 2017: Šumarski program Federacije BiH (*Forestry Program of the Federation of Bosnia and Herzegovina*). Sarajevo, Bosnia and Herzegovina. Available online: <https://fmpvs.gov.ba/wp-content/uploads/2017/Sumarstvo-lovstvo/Sumarski-program/sumprogr-opcidio.pdf> (accessed on 11 September 2022)
- FMAWMF – Federal Ministry of Agriculture, Watter Management and Forestry, 2019: Master plan šumske transportne infrastrukture Federacije Bosne i Hercegovine – Nacrt (*Master Plan of Forest Transport Infrastructure in the Federation of Bosnia and Herzegovina – Draft*). Sarajevo, Bosnia and Herzegovina. Available online: <https://fmpvs.gov.ba/wp-content/uploads/2017/Sumarstvo-lovstvo/Sumarski-program/Master-Plan-nacrt-sumarstvo.pdf> (accessed on 11 September 2022).

- Forest Research, 2022: Forestry Statistics 2022 – Chapter 9 International Forestry. Forest Research, Northern Research Station Roslin, Midlothian, UK, 24 p.
- FSO – Federal Statistical Office, 2020: Registered business entities in FB&H in the field 02 – forestry and logging. Sarajevo, Bosnia and Herzegovina, 2020, Available online: <http://fzs.ba/index.php/statisticke-oblasti/poslovne-statistike/sumarstvo/> (accessed on 11 September 2022).
- FSO – Federal Statistical Office, 2021: Forestry 2020 – bilten 336. Sarajevo, Bosnia and Herzegovina, 88 p. Available online: <http://fzs.ba/index.php/publikacije/godisnji-bilteni/sumarstv> (accessed on 11 September 2022).
- Gallis, C., 2006: Work-related prevalence of musculoskeletal symptoms among Greek forest workers. *International Journal of Industrial Ergonomics* 36(8): 731–736. <https://doi.org/10.1016/j.ergon.2006.05.007>
- Garland, J.J., 2018: Accident reporting and analysis in forestry: guidance on increasing the safety of forest work. Forestry Working Paper, No. 2. FAO, Rome, 77 p.
- GFBH – Government of the Federation of Bosnia and Herzegovina, 2017: Zakon o razvojnom planiranju i upravljanju razvojem u Federaciji Bosne i Hercegovine (*Law on Development Planning and Development Management in the FB&H*). Official Gazette of FB&H No. 32/17.
- GFBH – Government of the Federation of Bosnia and Herzegovina, 2020: Strategija razvoja Federacije Bosne i Hercegovine za period 2021–2027. (*Development Strategy of the Federation of Bosnia and Herzegovina for the period 2021–2027*). Sarajevo, Bosnia and Herzegovina, 203 p.
- He, M., Smidt, M., Li, W., Zhang, Y., 2021: Logging industry in the United States: employment and profitability. *Forests* 12(12): id 1720. <https://doi.org/10.3390/f12121720>
- ILO, 1998: Safety and health in forestry work. International Labour Office, Geneva, Switzerland, 118 p.
- ILO, 2019: Promoting decent work and safety and health in forestry. Report for discussion at the Sectoral Meeting on Promoting Decent Work and Safety and Health in Forestry. International Labour Office, Geneva, Switzerland, 45 p.
- ILO, 2021: Industries and sectors – Forestry, Wood, Pulp and Paper. Available online: <https://www.ilo.org/global/industries-and-sectors/forestry-wood-pulp-and-paper/lang-en/index.htm>
- Landekić, M., 2010: Organizacijska kultura i sigurnost pri radu u hrvatskom šumarskom sektoru. *Šumarski list* 134(11–12): 613–622.
- Landekić, M., Šporčić, M., Bačić, M., Pandur, Z., Bakarić, M., 2023: Workability and physical wellbeing among chainsaw operators in Croatia. *Croatian Journal of Forest Engineering* 44(1): 83–94. <https://doi.org/10.5552/crojfe.2023.2073>
- Landekić, M., Martinić, I., Bakarić, M., Ricart, R., Šporčić, M., 2017: Stručno osposobljavanje radnika u sektoru šumarstva – stanje u Hrvatskoj i trendovi u Europi. *Šumarski list* 141(7–8): 395–407. <https://doi.org/10.31298/sl.141.7-8.6>
- Lay, V., 2005: Integralna održivost i učenje. Društvena istraživanja: časopis za opća društvena pitanja 14(3)(77): 353–377.
- Lippe, R.S., Schweinle, J., Cui, S., Gurbuzer, Y., Katajamäki, W., Villarreal-Fuentes, M., Walter, S., 2022: Contribution of the forest sector to total employment in national economies – Estimating the number of people employed in the forest sector. Rome and Geneva, FAO and ILO, 25 p. <https://doi.org/10.4060/cc2438en>
- Loftalian, M., Emadian, S.F., Far, N.R., Salimi, M., Moonesi, F.S., 2012: Occupational stress impact on mental health status of forest workers. *Middle-East Journal of Scientific Research* 11(10): 1361–1365. <https://doi.org/10.5829/idosi.mejsr.2012.11.10.64170>
- Mijoč, D., 2022: Održivost radne snage u šumarstvu Federacije Bosne i Hercegovine. Doctoral thesis, University of Zagreb Faculty of Forestry and Wood Technology, Zagreb, 227 p.
- Musić, J., Obućina, M., Gurda, S., Halilović, V., 2013: Odnosi šumarstva i drvne industrije u Federaciji BiH. *Nova mehanizacija šumarstva* 34(1): 51–60.
- OG 101/23: Forest Act. Official Gazette of Republic of Croatia, No. 101/23.
- PLCM – Professional Logging Contractors of Maine, 2019: Maine logger and log trucker employment availability and wage analysis report – Data appendix. Maine Center for Business and Economic Research, University of Southern Maine, 33 p.
- Pravdić, V., 1998: Održivost, prirodni kapital i djelotvornost i njihovo značenje u obrazovanju za okoliš. *Socijalna ekologija: časopis za ekološku misao i sociologijska istraživanja okoline* 7(1–2): 133–139.
- Proteau, E., 2008: Future shortage of forest workers drives home need for recruitment efforts. *Linking Innovations & Networking Knowledge* 9(3): 1–3.
- Robb, W., Zemánek, T., Kaakkurivaara, N., 2022: An analysis of chainsaw operator safety between Asian and European countries. *Croatian Journal of Forest Engineering* 43(2): 373–389. <https://doi.org/10.5552/crojfe.2022.1539>
- Roca, Z., 1998: Positive experiences in increasing the involvement of young men and women in rural development in Portugal. Increasing the involvement of young men and women in rural development in Europe. REU Technical Series – 55. FAO regional office for Europe, Rome, Italy, 39–61 p.
- Şafak, I., Karademir, D., Okan, T., 2024: An assessment of Turkish forest fire workers' thoughts on occupational health and safety. *Croatian Journal of Forest Engineering* 45(2): 403–419. <https://doi.org/10.5552/crojfe.2024.2274>
- Šporčić, M., Landekić, M., Šušnjar, M., Pandur, Z., Bačić M., Mijoč, D., 2023: Deliberations of forestry workers on current challenges and future perspectives on their profession – a

case study from Bosnia and Herzegovina. *Forests* 2023 14(4): id 817. <https://doi.org/10.3390/f14040817>

Šporčić, M., Landekić, M., Šušnjar, M., Pandur, Z., Bačić M., Mijoč, D., 2024: Shortage of labour force in forestry of Bosnia and Herzegovina – forestry experts' opinions on recruiting and retaining forestry workers. *Croatian Journal of Forest Engineering* 45(1): 183–197. <https://doi.org/10.5552/crojfe.2024.2345>

Tsioras, P.A., 2010: Perspectives of the forest workers in Greece. *iForest – Biogeosciences and Forestry* 3(5): 118–123. <https://doi.org/10.3832/ifor0547-003>

Tsioras, P.A., 2012: Status and job satisfaction of Greek forest workers. *Small-scale Forestry* 11(1): 1–14. <https://doi.org/10.1007/s11842-011-9164-0>

UNECE/FAO, 2020: Forest sector workforce in the UNECE region – Overview of the social and economic trends with impact on the forest sector. Geneva timber and forest discussion paper 76. United Nations, Geneva, Switzerland, 77 p.

UNECE/FAO, 2021: Forest Sector Outlook Study 2020–2040. Geneva Timber and Forest Study Paper 51, United Nations, Geneva, Switzerland, 91 p.



© 2024 by the authors. Submitted for possible open access publication under the terms and conditions of the Creative Commons Attribution (CC BY) license (<http://creativecommons.org/licenses/by/4.0/>).

Authors' addresses:

Prof. Mario Šporčić, PhD

e-mail: sporcic@sumfak.unizg.hr

Assoc. prof. Matija Landekić, PhD *

e-mail: mlandekic@sumfak.unizg.hr

Assoc. prof. Zdravko Pandur, PhD

e-mail: zpandur@sumfak.unizg.hr

Marin Bačić, PhD

e-mail: mbacic1@sumfak.unizg.hr

Prof. Marijan Šušnjar

e-mail: msusnjar@sumfak.unizg.hr

University of Zagreb

Faculty of Forestry and Wood Technology

Svetošimunska cesta 23

10000 Zagreb

CROATIA

David Mijoč, PhD

e-mail: dmijoc@gmail.com

Hercegbosanske šume d.o.o. Kupres

Splitska bb

80320 Kupres

BOSNIA AND HERZEGOVINA

* Corresponding author

Received: April 22, 2024

Accepted: August 28, 2024