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Integration of Sustainable Development Goals in Higher Education and Research Processes Related to Forestry and Wood Science

Uključivanje ciljeva održivog razvoja u visoko obrazovanje i znanstvena istraživanja vezana za šumarstvo i drvo

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ABSTRACT • *Global challenges, including climate change, land and ecosystem degradation, and a growing population have direct or indirect impact on natural resources and are forcing people to seek new ways of production and consumption that respect the ecological limits of our planet. To meet the challenges, the 2030 Agenda for Sustainable Development was adopted by 193 countries at the United Nations Summit in September 2015. The forest-wood chain has also been identified as closely linked to sustainable development and the Sustainable Development Goals (SDGs). Especially in countries with high forest cover, such as Slovenia, forest-wood chain is recognized in policy documents as key element for achieving the SDGs. The importance of the SDGs is not only recognized in national legislation, but also in relation to higher education and research institutions. With the aim to investigate how well higher education teachers and students are familiar with SDGs and whether they consider them important for the forestry and wood industry and if high education teachers and researchers integrate the SDGs into educational programs and research, survey was conducted with the employees (n=61) and students (n=185) of the University of Ljubljana, Biotechnical Faculty, Department of Forestry and Renewable Forest Resources and Department of Wood Science and Technology. The results show that both employees and students of the Department of Forestry and Renewable Forest Resources as well as employees and students of the Department of Wood Science are familiar with SDGs. All the respondents find SDGs important for the forestry and wood industry. All the participants especially emphasized SDG 15 – Life on land. The results also showed that, in the future, employees of both departments plan to integrate more SDGs into their educational and research process. Finally, it was concluded that educational and research institutions and integration of SDGs into their educational and research process could be an important step towards sustainability and achieving goals of 2030 Agenda for Sustainable Development. Students who will work in the forestry and wood industry sectors in the future could integrate and promote more sustainable practises in the sectors if they have sufficient knowledge of the SDGs and high perception of sustainability.*

KEYWORDS: *sustainable development goals; forestry; wood science; education; research*

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SAŽETAK • *Globalni izazovi kao što su klimatske promjene, uništavanje zemljišta i ekosustava te sve veći broj stanovnika izravno ili neizravno utječu na prirodne resurse i potiču ljude da traže nove načine proizvodnje i potrošnje koji poštuju ekološka ograničenja našeg planeta. Kako bi odgovorile na te izazove, 193 zemlje usvojile su na skupu Ujedinjenih naroda u rujnu 2015. Agendu održivog razvoja do 2030. Lanac šuma – drvo također je prepoznat kao usko povezan s održivim razvojem i ciljevima održivog razvoja (SDG). Osobito je u zemljama koje imaju veliku pokrivenost šumama, poput Slovenije, lanac šuma – drvo u političkim dokumentima prepoznat kao ključni element za postizanje ciljeva održivog razvoja. Važnost ciljeva održivog razvoja nije naglašena samo u nacionalnom zakonodavstvu već i u obrazovnim i istraživačkim institucijama. Cilj istraživanja bio je utvrditi koliko su nastavnici i studenti u visokom obrazovanju upoznati s ciljevima održivog razvoja, smatraju li ih važnima za šumarstvo i drvnu industriju te integriraju li nastavnici i znanstvenici ciljeve održivog razvoja u obrazovne programe i istraživanja. Na Biotehničkom fakultetu Sveučilišta u Ljubljani, na Odsjeku za šumarstvo i obnovljive šumske resurse te na Odsjeku za znanost o drvu i drvnu tehnologiju, provedena je anketa sa zaposlenicima (n = 61) i studentima (n = 185). Rezultati pokazuju da su zaposlenici i studenti obaju odsjeka upoznati s ciljevima održivog razvoja. Svi ispitanici smatraju da su ciljevi održivog razvoja važni za šumarstvo i drvnu industriju. Svi su posebno istaknuli cilj održivog razvoja 15 – Život na kopnu. Rezultati su također pokazali da zaposlenici obaju odsjeka planiraju u budućnosti integrirati više ciljeva održivog razvoja u svoj obrazovni i istraživački proces. Zaključili smo da bi integracija ciljeva održivog razvoja u obrazovni i istraživački proces mogla biti važan korak prema održivosti i postizanju ciljeva Agende održivog razvoja do 2030. Studenti koji će u budućnosti raditi u sektoru šumarstva i drvne industrije mogli bi integrirati i promicati održive prakse u tim sektorima ako imaju dovoljno znanja o ciljevima održivog razvoja i visoku svijest o održivom razvoju.*

KLJUČNE RIJEČI: *ciljevi održivog razvoja; šumarstvo; znanost o drvu; obrazovanje; istraživanje*

1 INTRODUCTION
1. UVOD

Natural resources are the fundamental basis for life and human well-being. Global challenges, including hunger and poverty, gender inequality and inequality in general, climate change, land and ecosystem degradation, deforestation, biodiversity loss, resource depletion and a growing population have direct or indirect impact on natural resources and are forcing people to seek new ways of production and consumption that respect the ecological limits of our planet (European Commission, 2018).

Until 1972, these challenges were not adequately addressed neither by general public nor policy makers (UNEP, 2023). In 1972, the Declaration of the United Nations Conference on the Human Environment was adopted addressing global challenges. Since then, various policy documents were adopted such as the Rio Declaration on Environment and Development (1992), the Agenda 21 (1992), the Millennium Declaration (2000), the Johannesburg Declaration on Sustainable Development (2002) and the Rio+20 Outcome Document (2012), which, together with various other environmental and development conventions as well as regional and global commitments, led to the development of the 2030 Agenda for Sustainable Development (United Nations, 2015). The 2030 Agenda for Sustainable Development was adopted by 193 countries at the United Nations Summit in September 2015 (United Nations, 2015). The 2030 Agenda for Sustainable Development integrates the three dimensions of sustainable development - economic, social and environmental (United Nations, 2015). These three dimensions are integrated into the 17 overarching Sustainable Development Goals (hereafter: SDGs) and 169 associated targets, with the aim of addressing economic, social and environmental issues addressing crucial global challenges (Gue *et al.*, 2020; Niestroy, 2016; Ramirez *et al.*, 2019; Belmonte-Ureña *et al.*, 2021; Katila *et al.*, 2019). The SDGs and their targets form a complex, integrated system with clear sectoral emphasis but also strong interlinkages among goals and targets. The 2030 Agenda for Sustainable Development forms an overarching framework that is expected to guide government and non-state actors' efforts at different scales, from global to local, until 2030 (Katila *et al.*, 2019). Regarding the legal status of the SDGs, it is important to note that they are not legally binding at the national level. However, the 2030 Agenda for Sustainable Development influences and informs international agreements, policies and programmes (United Nations, 2015). Individual countries can integrate SDGs into their legal and policy frameworks and make them legally binding.

The 2030 Agenda for Sustainable Development offers an extensive framework for shaping and coordinating governmental policies. Cultural differences of the general public and understanding of sustainability can influence the willingness of people to accept and understand SDGs (Guan and Zhang, 2023). Some previous studies (Novieastari, 2022; Zamora-Polo *et al.*, 2019) suggest that the general public knowledge, especially among university students, about sustainability and 2030 Agenda for Sustainable Development is not sufficient.

Since forests cover about 35 % of European land, they are crucial for provisioning timber for wood industry (Forest Europe, 2020). Therefore, both sectors are crucial for sustainable development at all scales, from global to local. Forests are explicitly mentioned in the context of SDG 15 – *Life on land*, where sustainable use of forests and reversing biodiversity loss is mentioned. In relation to SDG 6 – *Clean water and sanitation,* forests are seen as water-related ecosystems (United Nations, 2015). Furthermore, there are strong synergies between forests and SDG 13 – *Climate action,* as forests are important for carbon sequestration and storage (United Nations, 2015). Although the wood industry is not explicitly mentioned in the context of the SDGs, there are strong links to SDG 9 – *Industry, innovation and infrastructure* (Mancini *et al.*, 2019). This specific goal is focused on promoting inclusive and sustainable industrialization, where wood, wood products and wood residues could represent a sustainable raw material for extended value chains organized along the key principles of circular bioeconomy (i.e., adding value through the cascading use biomass, closing the energy and material loops). In line with this, the wood industry can be considered as part of SDG 9 – *Industry, innovation and infrastructure* (United Nations, 2015; INTRuST, 2022). The forest-wood chain, considered by most countries as a sector that includes both forestry and wood processing, is also recognized in the connection with other SDGs like SDG 1 – *No poverty*, SDG 2 – *Zero hunger*, SDG 3 – *Good health and well-being*, SDG 5 – *Gender equality,* SDG 7 – *Affordable and clean energy,* SDG 8 – *Decent work and economic growth,* SDG 11 – *Sustainable cities and Communities* and SDG 12 – *Responsible Production and Consumption.* SDG 17 – *Partnerships for the goal* is also related to the forestry and wood industry because partnerships and support facilitate the achievement of the goals, not only in social initiatives, but also in the industry and above all in environmental protection strategies (Ma *et al*., 2022; Baumgartner, 2019; Hazarika and Jandl, 2019; United Nations, 2015).

Slovenia has a forest area of 58.0 % (ZGS, 2022). Consequently, wood is the most important strategic raw and industrial material (MGTŠ, 2021; MGRT, 2020). The importance of the forest-wood chain is recognized in multiple strategies and policy documents. For example, the Slovenian Development Strategy 2030 (MKRR, 2017), which is the fundamental strategic document of Slovenia, also recognizes the importance of forests and wood industry for achieving SDGs. Furthermore, the Slovenian Industrial Strategy 2021-2030 (MGTŠ, 2021) promotes wood-based industry, decarbonization of energy-intensive industries (e.g., paper industry) and transition to a low-carbon circular economy. This is also recognized in the National Energy and Climate Plan 2030 (MOPE, 2020). Forest-related policy documents (e.g., the Operational Programme of the National Forest Programme 2022-2026 (2022)), recognize sustainable forest management as a key instrument to achieve the 2030 Agenda for Sustainable Development Goals.

The importance of the SDGs is recognized not only in the national strategic documents, but also in the strategic documents of higher education and scientific research institutions (University of Freiburg, 2021; SLU, 2019; CZU, 2023; Wageningen University and Research, 2022; BOKU, 2020; Univerza v Ljubljani, 2022). The importance of SDGs is also recognized by the Biotechnical Faculty, which is part of the University of Ljubljana (Biotehniška fakulteta, 2023), where it is possible to study forestry and wood science. However, some previous research shows that there are also challenges and gaps in the implementation of SDGs in the higher education and research process globally (Grano and Correia, 2020). Anyhow, higher education and scientific research institutions can contribute to SDGs from a variety of perspectives: research, education, operations and governance and external leadership (SDSN Australia/Pacific, 2017). In addition, Belmonte-Ureña *et al.* (2021) report that scientific research plays a crucial role in the success of the SDGs, Walentowski *et al.* (2020) report that well-educated young academics are key to putting knowledge-based thinking into practice for responsible resource management for a sustainable world, and Zuluaga-Ortiz *et al.* (2022) report that universities influence the basic competencies of students in order to produce good professionals. In addition, some previous studies (e.g. Novieastari *et al.*, 2021; Omisore *et al*., 2017; Zamora-Polo *et al*., 2019) suggest that knowledge and awareness about the SDGs is not sufficient among young people, especially students in higher education. Based on the insights gained from reviewing previous research articles and the limited availability of research articles on the topic of higher education teachers and researchers' knowledge of the SDGs and their influence on students' knowledge of the SDGs, the aim of this study was to: 1) find out how well the higher education teachers, researchers and students of the Department of Forestry and Renewable Forest Resources (hereafter: Department of Forestry) and the Department of Wood Science and Technology (hereafter: Department of Wood Science) of the Biotechnical Faculty of the University of Ljubljana know the SDGs (i.e. acquaintance, understanding), and 2) whether they consider the SDGs to be important for the forestry and wood industry (i.e. perceived significance), and 3) investigate whether high education teachers and researchers integrate the SDGs into educational pro-

grammes and research, and 4) how they will integrate the SDGs into their educational and research process in the future.

2 METHODS
2. METODE

The data for this study was collected by developing the structured questionnaire for the employees (higher education teachers and researchers) and students of the Department of Forestry and the Department of Wood Science. The questionnaire for employees consisted of 17 questions and a questionnaire for students consisted of 10 questions. The questionnaire for employees was pre-tested in March 2023 by five employees, and the questionnaire for students was pre-tested by the same five employees in September 2023. Based on the pre-tests, both questionnaires were revised to make the questions as understandable and precise as possible. Most of the questions were Likert-type scale responses (Likert, 1932), some of them required additional explanations (open questions), and some were binary. The surveys were conducted on-line, using 1KA programme (FDV, 2017). The questionnaire was distributed to all employees who are engaged in educational or research process (n= 84) and all students (n= 440) of the Department of Forestry and the Department of Wood Science. The data (available in Uhan *et al.*, 2023) for employees were collected between 4 and 19 April 2023, and the data for students were collected between 15 September and 27 October 2023.

Within the employees' survey period activity, 61 persons completed the survey, which means that the response rate was 73 % (Figure 1). Within the students' survey period activity, 185 persons completed the survey, which corresponds to a response rate of 42 % (Figure 2).

The collected data were imported and coded in MS Excel and processed in JASP, version 17.1 (JASP team, 2023). To check the quality of the data and to detect errors, outliers and missing values, all data were first checked with frequencies. Variables in the questionnaires were analysed using frequency distributions and mean values. In order to determine the differences between departments, the non-parametric Mann-Whitney U test was used (Navarro *et al.*, 2019).

3 RESULTS AND DISCUSSION
3. REZULTATI I RASPRAVA

Altogether 61 higher education teachers and researchers completed the survey, 51 % from the Department of Forestry and 49 % from the Department of Wood Science. The largest share of respondents among employees of both departments were teaching assistants and researchers (31 %), followed by assistant professors (23 %), full professors (20 %), specialist advisers (13 %) and associate professors (8 %). One senior lecturer and a teacher of skills also participated in the survey. Among the respondents, the majority (over 90 % all together) are engaged in research work, and 66 % of them also identified themselves as being engaged in education (Figure 1).

Altogether 185 students responded to the survey, 44 % from the Department of Forestry and 56 % from the Department of Wood Science. Most of the students who participated in the survey in both departments were undergraduates, from Academic Study Programmes (51 %) and Professional Study Programmes (31 %), while the students enrolled in Masters' Study (18 %) made up a significantly smaller proportion of respondents (Figure 2). The distribution of the answers represents a direct consequence of number of enrolled students per specific studies and specific year as in both departments there are more students enrolled in Academic Study Programmes or Professional Study Programmes (Department of Forestry – 86 %, Department of Wood Science – 81 %).

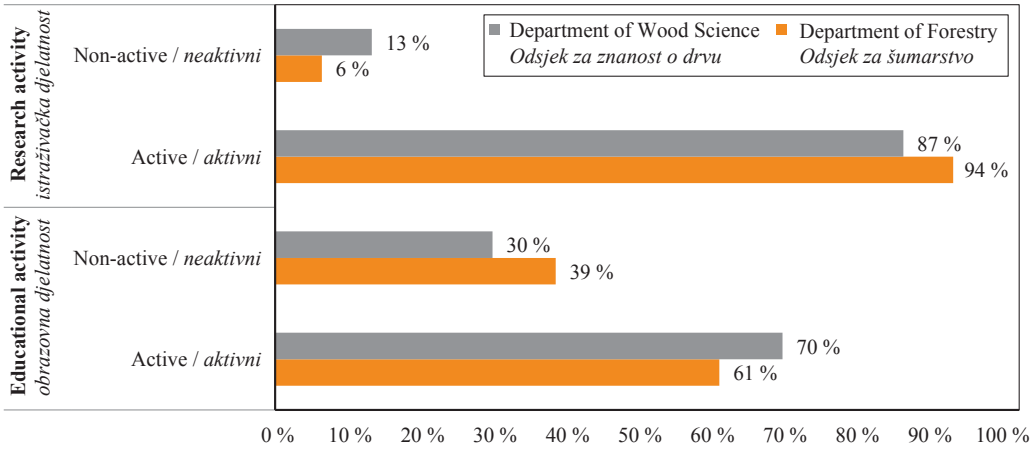

Figure 1 Respondents educational and research activities of employees
Slika 1. Obrazovne i istraživačke aktivnosti ispitanih zaposlenika

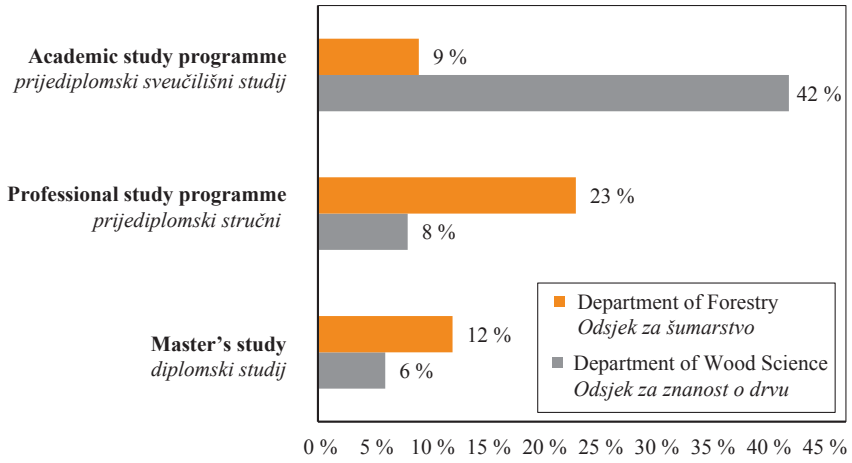

Figure 2 Distribution of students who have responded
Slika 2. Raspodjela studenata koji su odgovorili

3.1 General knowledge about sustainable development goals
3.1. Općenito poznavanje ciljeva održivog razvoja

The first part of the survey focused on the employees and students' general knowledge about the SDGs. Both rated their knowledge about the SDGs on a Likert-type scale from 1 (I know very little about the SDGs) to 5 (I know a lot about the SDGs). The employees rated their knowledge about the SDGs with an average value of 3.4, where 27 % rated their general knowledge about the SDGs as good. Furthermore, no statistical differences were found between employees of the Department of Forestry and the Department of Wood Science (*Mann-Whitney U-test, U=305*, *p=0.087*) in relation to their knowledge about the SDGs. Students rated their general knowledge about the SDGs with an average value of 2.9. 56 % of students rated their general knowledge about the SDGs as good. Among students from both departments no statistical differences were found (*Mann-Whitney U-test, U=4076.000, p=0.069*). Differences in general knowledge about the SDGs between employees and students were significant (*Mann-Whitney U-test, U=3608.000, p=0.003*), employees rated their general knowledge about the SDGs as better. The importance of familiarity with the SDGs was also studied by Jabeen (2022), who found that the knowledge about the SDGs had increased. Alm *et al.,* (2020), who studied student awareness and knowledge about the SDGs, emphasized that higher education teachers in higher education institutions and universities can play a crucial role in achieving the SDGs. However, previous studies report that low percentage of students and employees have good knowledge about the SDGs (Smaniotto *et al.,* 2019; Omisore *et al.,* 2017), which is not consistent with our study, especially concerning the results of students' survey. On the contrary, Fajar Jati *et al.* (2019) report that 89.5 % of students are aware of the SDGs and 62.5 % have good knowledge about the SDGs, which is in line with our results. However, Fajar Jati *et al.* (2019) focused only on students and did not include employees.

3.2 Importance of sustainable development goals for forestry and wood industry sectors
3.2. Važnost ciljeva održivog razvoja za sektor šumarstva i drvne industrije

The employees and students of both departments were asked to judge the general importance of the SDGs for the forestry and wood industry sectors (Figure 3 and Figure 4) on five-point Likert-type scale from 1 (Not important) to 5 (Very important). Both the employees and students of the Department of Forestry have rated SDG 6 – *Clean water and sanitation* and SDG 15 – *Life on land* as the most important SDGs for forestry. Employees rated both SDGs with an average value of 4.7, while students gave SDG 6 – *Clean water and sanitation* a lower value (average value 4.5) and SDG 15 – *Life on land* even lower rating (average value 4.4). The results are in line with expectations as forests are seen as one of the water-related ecosystems in SDG 6 – *Clean water and sanitation*. The emphasis on SDG 15 – *Life on land* is also expected as it focuses on the protection, restoration and sustainable use of terrestrial ecosystems, and halting the loss of biodiversity recognizes forests and their rich biodiversity as essential for sustainable development (Katila *et al.*, 2019). In addition, employees also rated SDG 7 – *Affordable and clean energy* (average value 4.5), SDG 12 – *Responsible consumption and production* (average value 4.5), and SDG 13 – *Climate action* (average value 4.5) as very important. Students additionally recognized the importance of SDG 12 – *Responsible consumption and production* (average value 4.2), and SDG 13 – *Climate action* (average value 4.2). Results are in line with previous research since forests play an important role in the supply chain for energy production, and because the role of forest is also recognized for ensuring access to affordable, reliable and sustainable energy services

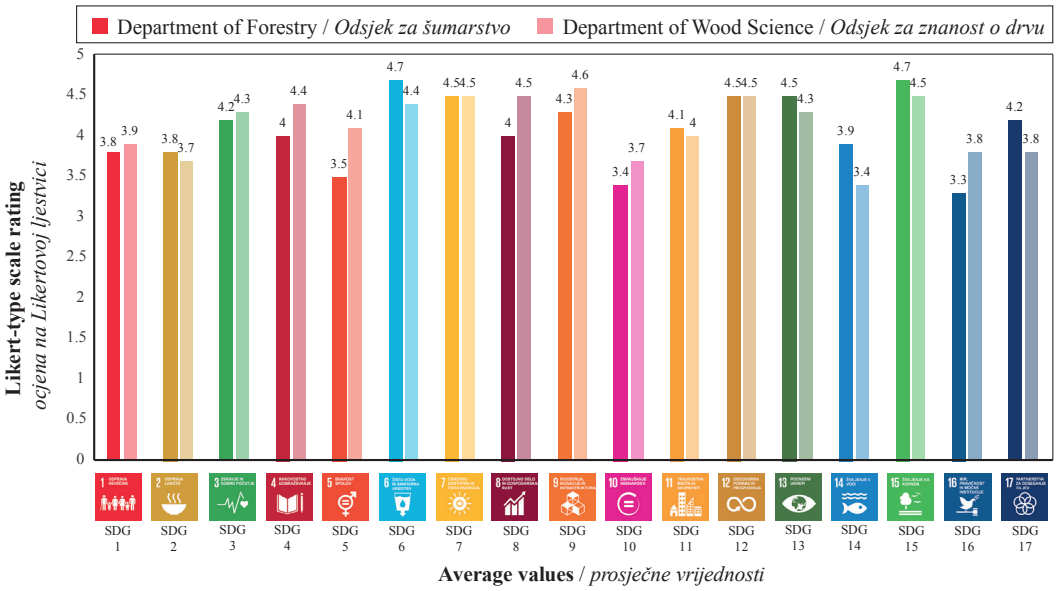

Figure 3 Importance of each SDG for forestry or wood sector (employees)
Slika 3. Značajnost svakoga od SDG-ova za šumarstvo ili drvnu industriju (zaposlenici)

though SDG 7 – *Affordable and clean energy* (Katila *et al.*, 2019). In addition, responsible consumption and production can make a positive contribution to forest conservation and contribute to a more sustainable supply of wood and forest raw materials (Katila *et al.*, 2019). Forests are regularly mentioned in the context of the climate change, carbon sequestration and storage, and reduction of greenhouse gas emissions, which is the main goal of SDG 13 – *Climate action* (Katila *et al.*, 2019).

The employees of the Department of Wood Science have rated SDG 9 – *Industry, innovation and infrastructure* as the most important, with an average value of 4.6. Results are expected as this goal is centred on three main pillars: industry, infrastructure and innovation, which is the focus of wood industry sector (United Nations, 2015). In addition, the employees also recognized SDG 7 – *Affordable and clean energy* (average value 4.5), SDG 12 – *Responsible consumption and production* (average value 4.5), and SDG 15 – *Life on land* (average value 4.5) as important. Students from the Department of Wood Science recognize the majority of SDGs as important for wood industry: SDG 2 – *Zero hunger*, SDG 3 – *Good health and well-being,* SDG 4 – *Quality education,* SDG 6 – *Clean water and sanitation,* SDG 7 – *Affordable and clean energy,* SDG 8 – *Decent work and economic growth,* SDG 9 – *Industry, innovation and infrastructure* and SDG 15 – *Life on land* (with average value 4.5 each). The recognition of SDG 7 - *Affordable and clean energy* is also expected as wood industry contributes to the affordable and clean energy through sustainable

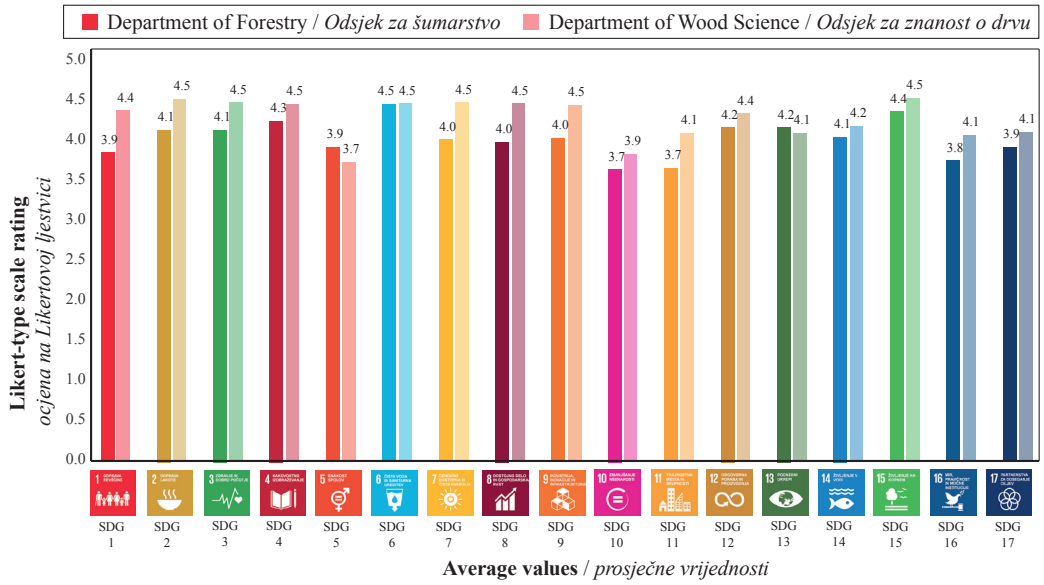

Figure 4 Importance of each SDG for forestry or wood sector (students)
Slika 4. Značajnost svakoga od SDG-ova za šumarstvo ili drvnu industriju (studenti)

use of traditional wood fuels (firewood and charcoal), processed wood fuels (pellets), liquid biofuels and biopower, which can play an important role in the provision of energy (Katila *et al.*, 2019). The relation to SDG 12 – *Responsible consumption and production* is also expected as the wood industry promotes responsible consumption and production, as wood is neither a toxic raw material nor hazardous waste (Verkerk *et al.*, 2021; Maier, 2021). Furthermore, wood industry offers complementary opportunities to forestry to achieve the SDGs within the forest-wood chain, so the importance of the wood industry in the context of SDG 15 – *Life on land* is predictable. SDG 15 – *Life on land* focuses mainly on the sustainable management of all types of forests and halting deforestation, to which a responsible and sustainable wood industry can contribute (Katila *et al.*, 2019); this can explain why the employees and students emphasized this SDG. Finally, SDG 8 – *Decent work and economic growth,* that was identified by both employees and students of the Department of Wood Science as an important one (average value 4.5), which mainly refers to the promotion and support of sustainable economic growth, is probably recognized because wood industry is related to sustainable economic growth (Maier, 2021).

3.3 Integration of sustainable development goals into higher educational and research process

3.3. Uključivanje ciljeva održivog razvoja u proces visokoškolskog obrazovanja i istraživanja

The survey conducted among employees of both departments also included the part about the integration of the SDGs in their research and educational process. These results were compared with the students' answers, to determine whether the students recognize the integration of the SDGs into the educational process in both departments. The results of the employees of both departments (Figure 5 and Figure 6) show that higher education teachers at the Department of Forestry most frequently integrate SDG 13 – *Climate Action* (average value 4.0) and SDG 15 – *Life on land* (average value 4.0) into their educational process, which is expected as both SDGs are related to the sustainable use of natural resources (United Nations, 2015). For example, SDG 13 – *Climate action* and SDG 15 – *Life on land* are integrated in the courses: Wildlife Ecology and Management Planning, Management of Wildlife Populations, Close-to-nature Silviculture, Silviculture, Dendrology with Breeding of Forest Trees, Introduction to Nature Conservation, The Basics of Forest Protection, Use of Forest Biomass and Forest Policy. It was also found that the research process of the employees of the Department of Forestry is mainly related to SDG 15 – *Life on land* (average value 3.1) and SDG 13 – *Climate action* (average value 2.7); however, the integration of the SDGs into their research work is much lower. For example, the employees of the Department of Forestry are currently engaged in the projects related to SDG 13 – *Climate action* (average value 2.7) (*Learning to realize multiple forest policy objectives under climate related stress and disturbance* and *Natural regeneration and tending of forests following large-scale disturbances: harmonization of ecological, economic and forest policy aspects)* and to SDG 15 – *Life on land* (average value 3.1) (*Efficient management of private forests to support wood mobilization*, *Learning to realize multiple forest policy objectives under climate related stress and disturbance*, and *Support for improved management of the interactions between large herbivores and forests*).

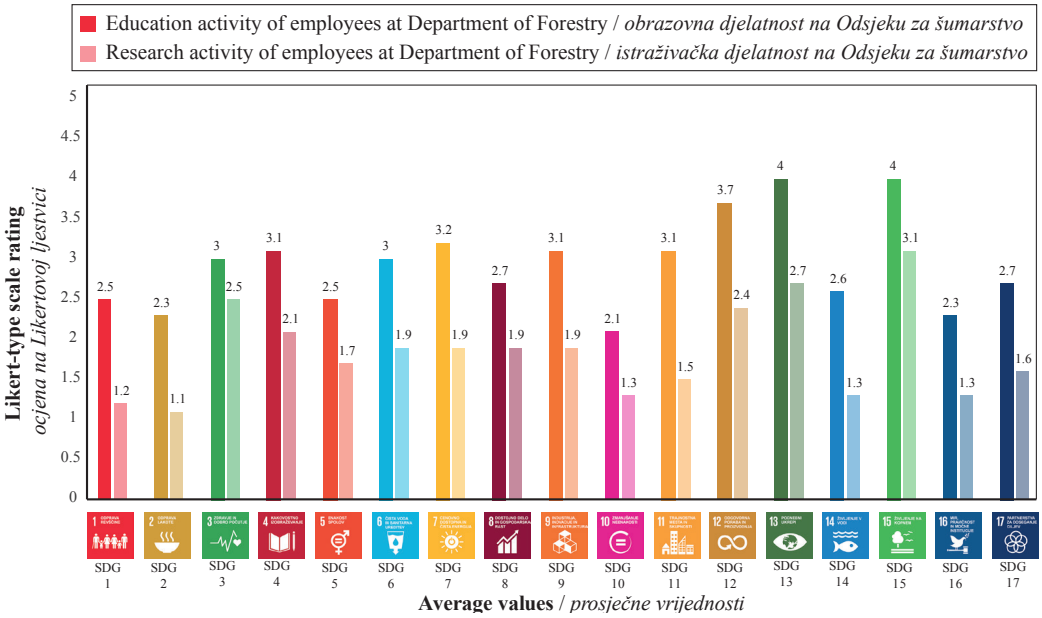

Figure 5 Involvement of SDGs in teaching and research at Department of Forestry and Renewable Forest Resources
Slika 5. Uključenost SDG-ova u obrazovanje i istraživanje na Odsjeku za šumarstvo i obnovljive šumske resurse

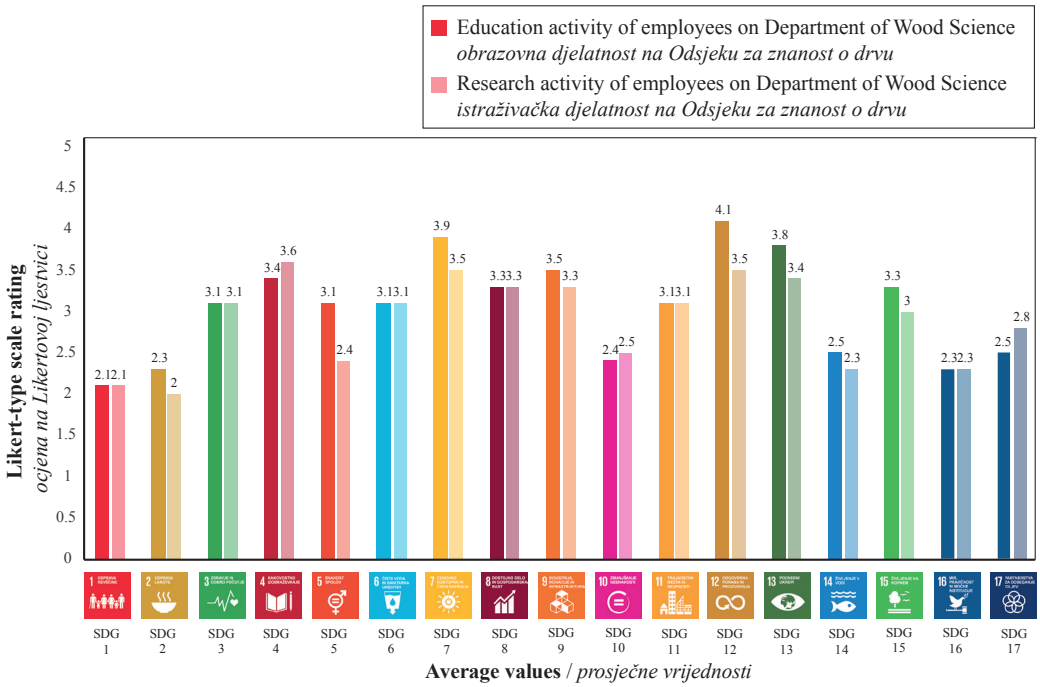

Figure 6 Involvement of SDGs in teaching and research at Department of Wood Science and Technology
Slika 6. Uključenost SDG-ova u obrazovanje i istraživanje na Odsjeku za znanost o drvu i drvnu tehnologiju

On the contrary, higher education teachers from the Department of Wood Science most frequently integrate SDG 12 – *Responsible Consumption and Production* (average value 4.1) and SDG 7 – *Affordable Clean Energy* (average value 3.9) into their education and research process. For example, SDG 12 – *Responsible consumption and production* and SDG 7 – *Affordable and clean energy* are integrated, in the courses: Environmental Protection in Wood Industry, Biotechnology in Wood Industry, Biotechnology of Higher Fungi, Environmental and Economic Aspects of Wood Protection and Wood Modification, Economics of Wood-Industry Company and Basics of Entrepreneurship, Management of Wood Industry Company with Microeconomics, Management of Production Processes in Wood Industry, Organization of Production in Wood Industry Company. Similar to the Department of Forestry, the SDGs are considered to a lower extent in the research process of employees of the Department of Wood Science than in the educational processes. The research process currently relates to SDG 4 – *Quality education* (average value 3.6) (*Alliance of Centres of Vocational Excellence in the Furniture and Wood Sector, Study in the shortage of personnel in the wood industry as a basis for the renewal of training* and SDG 7 – *Affordable clean energy* (average value 3.5) (*Affordable Clean Energy*: *Wood and Lignocellulosic Composites)*.

Further, answers of the employees from both departments were compared with the students results (Figure 7). The results show that the students from the Department of Forestry find SDG 12 – *Responsible consumption and production* (average value is 4.1) as the most integrated SDG in the forestry studies, followed by SDG 12 - *Responsible consumption and production*, SDG 7 – *Affordable and clean energy* (average value is 3.9), SDG 13 – *Climate action* (average value is 3.8) and SDG 9 – *Industry, innovation and infrastructure* (average value is 3.5). These SDGs are integrated, for example, into the courses: Close-to-nature Silviculture, Silviculture, Forest Management and Planning, Introduction to Nature Conservation, Basics of Forest Protection, Forest Policy, Meteorology, Old-growth Forests and Forest Reserves and Planning of Harvesting Technologies. Students from the Department of Wood Science emphasized only two SDGs– SDG 4 – *Quality education* (average value is 3.6) and SDG 7 – *Affordable and clean energy* (average value is 3.5). These SDGs are integrated, for example, into the courses: Environmental Protection in Wood Industry, Environmental and Economic Aspects of Wood Protection and Wood Modification, Economics of Wood-Industry Company and Basics of Entrepreneurship, Management of Wood Industry Company with Microeconomics, Management of Production Processes in Wood Industry, Organization of Production in Wood Industry Company and Technical Mechanics.

SDGs are integrated into education and research process at the Department of Forestry and the Department of Wood Science, probably because most of the current research programmes (e.g., Horizon Europe, Interegg Europe, Forestvalue, Forestvalue2) include topics related to sustainable development and achieving SDGs (Borchardt *et al*., 2023; European Commision, 2020; Interreg Europe, 2023; Forestvalue, 2023). Moreover, research process in higher education institutions is

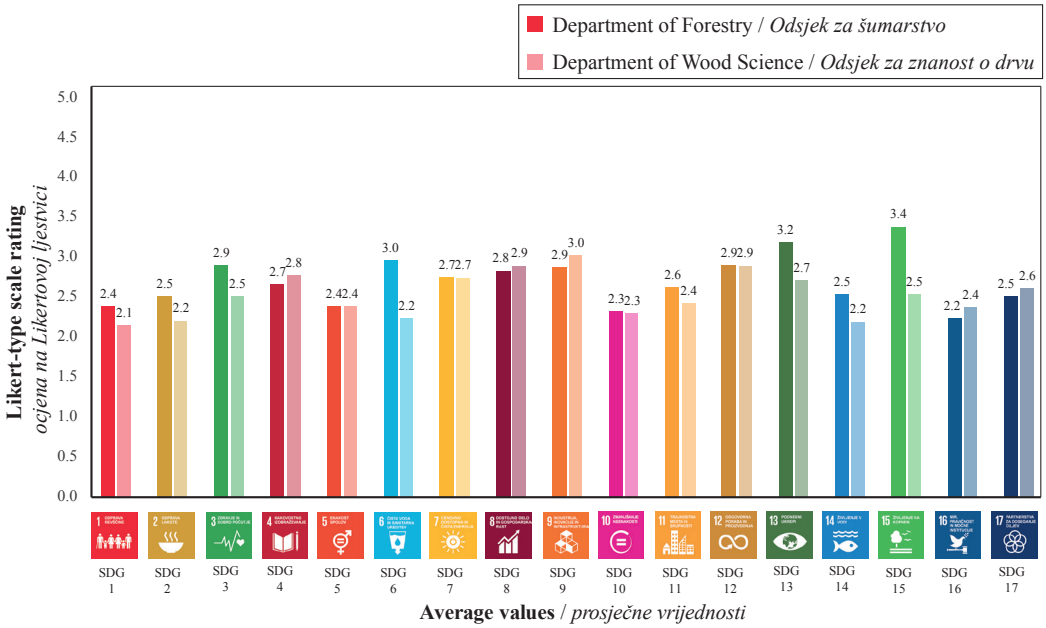

Figure 7 Involvement of SDGs in teaching at Department of Forestry and Department of Wood Science based on students' responses
Slika 7. Uključenost SDG-ova u obrazovanje i istraživanje na Odsjeku za šumarstvo i Odsjeku za znanost o drvu na temelju studentskih odgovora

directly related to the education process and therefore SDG 4 – *Quality education* (Elsen *et al.*, 2009). The student's responses confirm that courses in both departments integrate SDGs, but students do not always recognize that specific SDGs are integrated into the course, as the results show that students recognized different courses in relation to SDGs and emphasized different SDGs than employees, which could be a consequence of the limitations regarding emphasis on the SDGs, which was also recognized by Leal Filho (2023).

3.4 Future integration of sustainable development goals into educational and research process
3.4. Uključivanje ciljeva održivog razvoja u proces visokog obrazovanja i istraživanja u budućnosti

This part of the research focused only on employees of both departments. They were asked whether they intend to incorporate more SDG-related content in their educational and/or research process in the future. Employees of both departments rated this question with an average value of 3.7 on a Likert-type scale from 1 (I will not include the SDGs at all) to 5 (I will definitely include the SDGs). From the results, it can be concluded that SDGs are likely to be more included in the educational and research process of employees of both departments. The results are promising since integrating sustainable development and SDGs into the educational programmes, curricula and research creates meaningful learning outcomes (Lozano *et al.*, 2017; Alm *et al.*, 2020; Walentowski *et al.*, 2020; Belmonte-Ureña *et al.,* 2021).

4 CONCLUSIONS
4. ZAKLJUČAK

Sustainable development is a comprehensive topic that affects the economy, society and environment. Further, forest-wood chain represents an opportunity to achieve the 2030 Agenda for Sustainable Development. Moreover, higher education and research institutions were recognized as important actors who should integrate SDGs into their research and educational process and spread awareness about sustainability. Employees at the Department of Forestry and the Department of Wood Science of the Biotechnical Faculty of the University of Ljubljana already integrate SDGs in both educational and research processes. Further, it is important to note that the employees intend to include more SDGs in their work in the future, recognizing that their curriculum influences students' knowledge about the SDGs and their perception of sustainability. Based on these facts it can be concluded that educational and research institutions and integration of SDGs into their educational and research process could be an important step towards sustainability and achieving goals of 2030 Agenda for Sustainable Development. Students who will work in the forestry and wood industry sectors in the future could integrate and promote more sustainable practises in the sectors if they have sufficient knowledge of the SDGs and high perception of sustainability. New approaches in the industry could help in achieving goals of the 2030 Agenda for Sustainable Development. The study and its findings open up an interesting discussion on the relevance of the SDGs for higher education in the forest-wood chain.

The study must consider some limitations regarding the interpretation of the results, as there were some limitations in the survey implementation. The main drawback of the study is that the population studied is very limited as it focuses on only two departments of one university. However, the results open up promising possibilities for a future extension of the study to similar higher education programmes at other universities (Europe and globally). Another major drawback is that the results are based on self-assessment. Therefore, the results, especially the answers to the questions on familiarity with the SDGs, cannot be viewed with absolute certainty.

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