Article

How Are Wood and Non-Wood Forest Products Utilized in the Czech Republic? A Preliminary Assessment of a Nationwide Survey on the Bioeconomy

Ratna C. Purwestri [ID]**, Miroslav Hájek *, Miroslava Šodková and Vilém Jarský** [ID]

Faculty Forestry and Wood Sciences, Czech University of Life Sciences Prague, Kamýcká 129, 16500 Praha 6–Suchdol, Czech Republic; purwestri@fld.czu.cz (R.C.P.); sodkova@fld.czu.cz (M.Š.); jarsky@fld.czu.cz (V.J.)

* Correspondence: hajek@fld.czu.cz; Tel.: +420-224-383-707

Abstract: The Czech forests occupy 33.7% of the total country area; thus, wood and non-wood forest products (NWFPs) are important resources for the country. To date, the country has not adopted a forest bioeconomy strategy. A forest bioeconomy is defined as all activities that relate to the forest ecosystem services (FES). This study aimed to provide an initial evaluation regarding the use of forest products and related factors, and to make recommendations on developing wood consumption and promoting other FES for the adoption of a forest bioeconomy strategy in the country. The research study was part of a nationwide survey in June 2019. An online panel of 1050 respondents aged 18–65 years old was recruited based on a quota sampling procedure. Wood products were the most preferred material for furniture (96.3%) and building materials (46.3%). In total, 38.6% of Czech residents used wood as a source of energy, mostly in the form of firewood. It is challenging to switch the practice from using fossil-based heating to wood boiler energy source. The further development of wood into products with a high added value is recommended. Picking mushrooms and berries were among the popular activities in relation to NWFPs. The promotion of wood and NWFPs is encouraged, starting with increasing awareness and knowledge of the strength of the forest-based sector as a renewable energy resource and the importance of FES, using different channels as sources of information.

Keywords: forestry; wood; non-wood forest products; bioeconomy

1. Introduction

As a result of growing concerns about dependency on fossil-based energy-sources and their impact on climate change, as well as increasing awareness of and preference for sustainable production and consumption patterns, bioeconomy has become a significant solution. The European Commission (EC) defined the bioeconomy as an economy that "*encompasses the production of renewable biological resources and their conversion into food, feed, bio-based products, and bioenergy*". Agriculture, forestry, fisheries, food, pulp, and paper production, as well as some of the chemical, biotechnological and energy industries, are expected to contribute to bioeconomy activities [1,2]. Many of the strategies were further developed to improve the national economy and create job opportunities, and at the same time manage the forest sustainably. In addition to the above definitions, Winkel [3] described the forest-based bioeconomy as "*all economic activities that relate to forests and forest ecosystem services, including biomass-based value chains and the economic utilization of other types of forest ecosystem services (FES)*".

Forest-based wood production is leading the way to renewable energy sources, which are part of a long tradition in European countries [4,5]. In addition to wood forest products, forests offer valuable

forest ecosystem services and other benefits for the well-being of the people [6]. The services provided include provisioning and regulating, as well as basic, supportive and cultural services. Provisioning services cover the products obtained from ecosystems, e.g., food, water, construction and firewood, and fiber, while regulating services cover the benefits obtained from the regulation of ecosystem services, such as erosion control, climate regulation, and precipitation. Cultural services are defined as all nonmaterial benefits obtained from the forest, including spiritual, aesthetic, religious, and recreational values, all of which contribute to our well-being, social and cultural functions. Forests also provide supporting services that are necessary for the production of all other ecosystem services, e.g., nutrient and water cycling, soil formation and retention, and photosynthesis. [6–14].

In the Czech Republic, forests cover about 2.7 million ha (33.7%) of the total country area, lower than all European Union (EU) countries together (40.3%) and Austria (45%), but comparable to the German forested landscape (±31%) [15–18]. Forests are an important part of Czech history and culture. Based on the 2017 Czech forest report, forestry (forestry and logging) and the wood processing industry's shares accounted for 1.180% of the gross value added (GVA) at basic prices, not including the paper and furniture industries, which would add a contribution up to 2.018% of the GVA. The share of the forestry and wood processing industry alone was slightly lower than agriculture's share (1.713%), indicating the importance of the forest-based sector in the country [19].

Due to a growing global concern to replace fossil-based fuels with renewable energy sources, the forest-based sector has become a backbone for bioeconomy strategy. A shift in wood production from weakly regulated forests toward sustainable forest management is accompanied by third-party certification, as promoted in forest strategies in EU countries like Finland, Sweden, Germany, and Austria, that has changed the demand for wood in these regions. In 2014, Sweden became the top producer of primary wood products among EU countries by approximately 70 million m^3, followed by Finland (± 57 million m^3) and Germany (about 54 million m^3), while the Czech Republic and Austria contributed about 15 and 17 million m^3, respectively [20]. The Czech Republic was also named as one of the main roundwood exporter countries in 2016 [21]. In 2017, timber production in the Czech Republic resulted in 19,387 million m^3, of which roundwood production amounted to 11,488 million m^3. Most of timber production, including softwood–roundwood, and pulpwood, is exported, mainly to Austria and Germany, for further processing. However, the supply for sawmills and pulp mills in some regions is still insufficient, and this has caused the country to import from Slovakia, Germany, and Poland [19,22].

Although the bioeconomy strategy has not been mentioned in the Czech National Forest Programme (NFP) [16], bioeconomy has been mentioned in the 2018 draft strategy of the Ministry of Agriculture (MoA). In addition to timber production as one of the fundamental priorities in the Czech forest-based sector, non-wood products, like forest fruits and mushrooms, are also considered important FES [22]. Thus, it is important to provide a view of the current situation of forest products' utilization and preferences by the Czech public. The results can be used to inform policymakers and other stakeholders to offer better understanding, and as a baseline to make recommendations on further actions for the adoption of the forest bioeconomy strategy and the promotion of FES.

2. Materials and Methods

2.1. Study Area

The Czech forests cover about 33.7% of the total country area. In 2017, 71.9% of the total Czech forests consisted of coniferous trees, 50.3% of them being Norway spruce (*Picea Abies*). Deciduous trees, such as beech (8.4%) and oak (7.2%), covered 27% of the total forested region, and the rest (1.1%) was forested land without trees [19].

2.2. Design of the Study

The research study was part of a nationwide survey. The survey itself was part of the "Advanced research supporting the forestry and wood-processing sector's adaptation to global change and the 4th industrial revolution" and the "Diversification of the Impact of the Bioeconomy on Strategic Documents of the Forestry-Wood Sector as a Basis for State Administration and the Design of Strategic Goals" research project. The study was carried out in June 2019 in co-operation with an external market research company, REMMARK, a.s (Prague, Czech Republic). The company used the computer-assisted web interviewing (CAWI) technique to recruit the online respondents. No private information was required, and the respondents were anonymous. The online participants aged 18–65 years were recruited proportionally based on age, sex, education level, region, and village size. This technique generates emails and sent the questionnaires to the potential respondents based on the company's list through different online platforms, (e.g., Yahoo email). We have no information on the number of sent-out questionnaires. The survey was terminated after reaching the minimum required sample size. All returned questionnaires were included in the analysis (100%). The respondents were asked to answer a closed-ended questionnaire consisting of socio-demography characteristics and information on FES utilization. Additional information could be written/typed, in order to explain the answer option "others". The answers were later grouped and coded for further analysis.

2.3. Data Analysis

Descriptive data for the general characteristics of the respondents were used for single traits. Frequencies were presented by absolute numbers and their proportions. A group comparison of traits that determine the FES was made via a chi's square test or the Fischer exact test for categorical data. The age of the respondents was checked against an expected normal distribution using quantile-quantile (Q-Q) plot.

The target respondents of the survey were within a productive age. The age of the respondents was categorized as 18–24 (youth employment), while 25–54 and 55–65 years were defined as prime and mature working age, respectively [23,24]. The education levels of the respondents were categorized as elementary school, secondary school without official graduation or with vocational training (secondary school/vocational training), graduated from high school, or university level. In this article, the place of residence was grouped based on region. To fulfill further data analysis, we combined the respondents that never visited the forest with those who went one or two times per year and created a dummy variable of 0 = frequent visitors and 1= never/rarely. The frequency of forest visits is considered as one of the indicators of utilization of FES.

Two scoring systems were used to define the preferences and opinions of the respondents. The first method used five categorizations of opinions as follows:

(1) Certainly not;
(2) Rather not;
(3) Neither;
(4) Rather yes;
(5) Certainly yes.

The second method applied five degree of preferences, in which 1 (one) is most preferred and 5 (five) is least preferred.

Binary logistic regression with a forward stepwise approach was applied to identify potential predictors of the frequency of forest visits and utilization of forest products and ecosystem services. The following covariates associated with the dependent variables were included in the initial model: age, education level, and characteristics of the place of residence.

To designate the statistical significance in all analyses, a *p*-value of less than 0.05 was used. Statistical analysis was performed using IBM SPSS statistics version 25 (IBM Corp., Armonk, NY, USA).

3. Results

In total, 1050 respondents age 18–65 years were recruited in the study. As the samples were proportionally drawn by population size per region and village, the proportions of the residential locations of our respondents were similar to the national statistics office [25].

3.1. Forest Visitor General Characteristics

Respondents to the survey were from different education levels and age groups, of people aged between 18 and 65 years (Table 1). Respondents at the elementary school level were mostly from the younger age group. The respondents' data on education levels were similar ($p = 0.373$) to those from the Czech statistics office in 2011. The proportion of Czech citizens who graduated from elementary, secondary school without official graduation, high school, and university level that were reported by the national statistics office were 17.2%, 33%, 27.1%, and 12.5%. [26].

Table 1. General characteristics of the respondents (N = 1050).

| Characteristics	Percentage (n) or Mean ± sd (Min–Max)
Gender (female)	49.2 (517)
Age (years),	42.4 ± 13.5 (18–65)
Age group	
- 18–24 years	10.0 (105)
- 25–54 years	65.4 (687)
- 55–65 years	27.0 (283)
Education level	
- Elementary school	10.4 (109)
- Secondary school/vocational training	37.7 (396)
- High school graduates	36.3 (381)
- University	15.6 (164)
Place of residential (region)	
- Prague (capital city)	13.9 (146)
- Bohemia	53.5 (562)
- Moravia	32.6 (342)
Size of the city	
- up to 1000 inhabitants	16.2 (170)
- 1001–5000 inhabitants	20.8 (218)
- 5001–20,000 inhabitants	18.2 (191)
- 20,001–100,000 inhabitants	21.5 (226)
- > 100,000 inhabitants	23.3 (245)
Frequency of forest visits	
- Several times/week	17.0 (178)
- Once a week	27.0 (283)
- Once a month	33.2 (349)
- One or two times/year	21.8 (229)
- Never	1.0 (11)

The majority of respondents reported that they visited the forests regularly (about 77.1%), 21.8% of them admitted they rarely went to a forested region (one or two times per year), and only 1.0% of them never visited the forest. Those who had never visited the forest came from lower education levels (three from elementary and eight persons from secondary school/vocational training), aged between 25–54 years.

When we used binomial groups of forest visitors (0 = frequently, 1 = never and one or two times per year) and correlated the groups with other characteristics of the respondents, we found that significantly more people visited forests regularly across the regions than those who never went or went once or twice per year ($p = 0.048$). However, 46.7% of respondents from secondary school/vocational training graduates were found to be in the group of never to rarely visiting the forest, which was significantly higher than other groups of education levels ($p = 0.004$). Binary logistic regression revealed

the predictor of secondary school/vocational training were about 1.6-fold more likely (95% confidence limit of 1.21–2.17) to rarely to never visit the forest (*p* = 0.001).

3.2. Wood-Based Forest Products

In total, 46.3% of respondents considered that wood is a better material for building construction than other non-wood materials. The reasons for selecting wood as a material used in building construction are presented in Figure 1. The major positive reasons were its short preparation and environmentally-friendly material, followed by it being an energy saver and having a reasonable price. In contrast, its short lifespan and non-fireproof material prevented respondents from selecting wood as a building material.
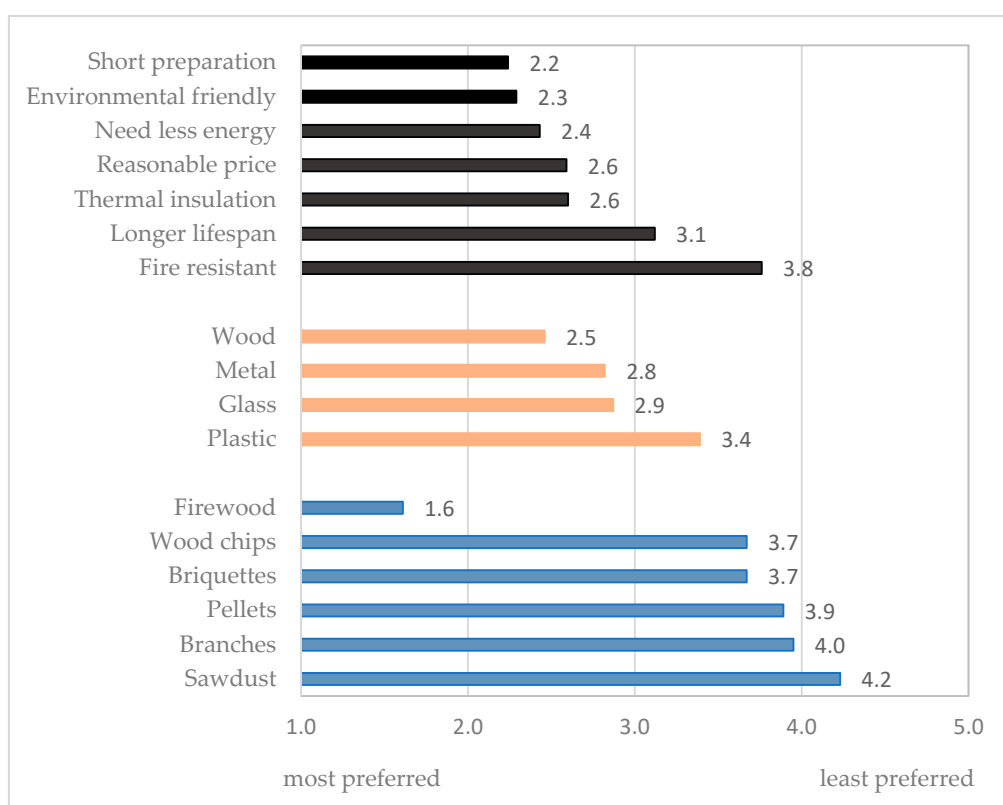
■ : Reasons for selecting wood as a building material (n = 1050)
■ : Preferences of furniture material (n = 1050)
■ : Type of wood preferences for source of energy (n = 450)

Figure 1. Reasons for selecting wood as a building materials (n = 1050), preferences of furniture material (n = 1050), and type of wood preferences for source of energy (n = 450).

Woods are the most preferred material for furniture over metal, glass, and plastic. As many as 96.3% of the respondents answered with a score of one (1) or two (2) for a preference of wood materials.

In total, 38.6% (n = 405) of the respondents were users of fireplaces, wood stoves/burners, or wood boilers. Firewood was the most favoured, while sawdust was the least preferred compared to other types of fuelwood (Figure 1).

3.3. Selected Non-Wood Forest Products Utilization

In this study we used the terminology of non-wood forest products based on the Food and Agriculture Organization (FAO) definition that excludes all woody raw materials [27]. Table 2 presents

information about the NWFPs' utilization by the respondents and/or their family members. Mushrooms were the most favoured NWFPs (58.5% and 27.4% of the respondents certainly and rather used them, respectively), followed by forest berries. Forest herbs and flowers were among the least utilized NWFPs. The preferences were similar across age groups and education levels.

Table 2. Utilization of non-wood forest products.

Non-Wood Forest Products (N = 1050)	Utilization % (n)				
	1 (Certainly Not)	2 (Rather Not)	3 (Neither)	4 (Rather Yes)	5 (Certainly Yes)
Mushrooms	2.5 (26)	3.5 (37)	8.1 (85)	27.4 (288)	58.5 (614)
Berries	2.8 (29)	6.6 (69)	12.1 (127)	30.7 (322)	47.9 (503)
Forest honey	15.6 (164)	15.6 (164)	19.1 (201)	27.0 (284)	22.6 (237)
Forest herbs	9.1 (96)	23.7 (249)	24.6 (258)	23.5 (247)	19.0 (200)
Forest flowers	26.6 (279)	27.1 (285)	18.8 (197)	16.5 (173)	11.0 (116)

In total, 46.7% of the respondents reported that they did not consume meat from game animals, followed by 18.6% and 21.4% of them, who consumed it less than two times and two to four times per year, respectively. A few of the respondents reported the frequent consumption of game animals of five to eleven times per year (7.1%), once a month (3.7%), and more than once a month (2.5%).

Among respondents who utilized NWFPs, gender played a role in their preferences. Female respondents utilized herbs (54.6%) and flowers (54.7%) significantly more than male respondents (45.4% and 45.3%, respectively). Additionally, more male respondents were engaged in the consumption of game animals. The youngest age group and elementary school graduates were major forest flower collectors for decoration.

3.4. Sources of Information

The main sources of information about forests were collected to identify the means of communication utilized by the respondents. We discovered that television (55%), followed by friends and families (39.6%), were the main sources of information. Online news (32.2%) was used as a source of information in almost the same proportion as social media (29.6%). Radio and printed media as two conventional sources of news were still used by 14.6% and 13.3% of people in the country, respectively. Out of 4.4% (n = 46) of respondents who reported gathering information about forests from other sources, almost half of them (n = 20) said they had gained it from their own experiences after visiting the forest, followed by seven respondents who had obtained it from an official forestry website.

When correlating age and education level with source of information, the proportion of TV viewers (n = 578) was dominant across all age groups and education levels (Figure 2). The young age group of 18–24 years old, and respondents with a higher education level, were the major users of all of the provided sources of information.

Especially within older age groups of respondents, the preference for receiving information from TV was more than 60%. A high proportion of respondents of secondary school/vocational training were TV viewers (61.1%). The majority of respondents within the age group of 18–54 years utilized online news and social media as their primary sources of news. Among users, male respondents (56.5%) were online media readers ($p = 0.012$), while the women were social media users (55%, $p = 0.018$). Peer groups and families were considered an important source of information, especially within the age group of 18–24 years old. Although radio and printed media were at the bottom two of the sources, retired respondents still considered radio as an important information provider.
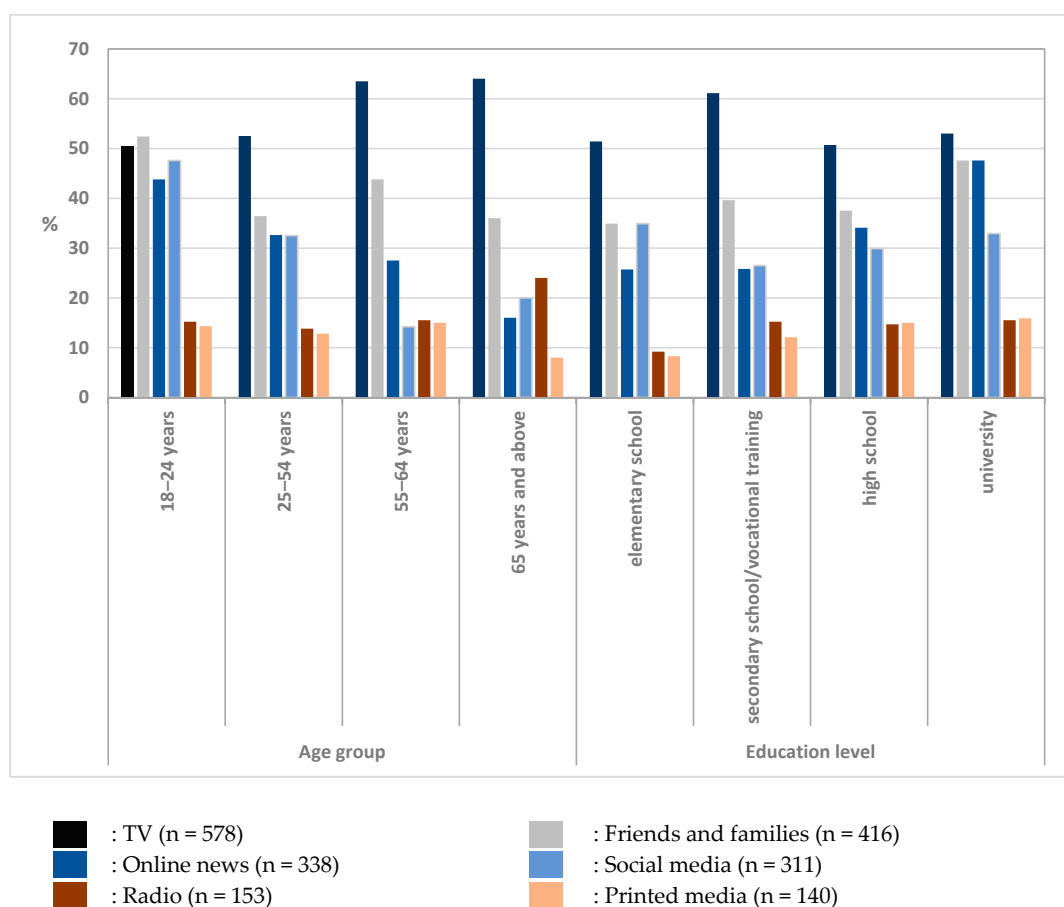
: TV (n = 578)　　　　　　　　　　　: Friends and families (n = 416)

: Online news (n = 338)　　　　　　: Social media (n = 311)

: Radio (n = 153)　　　　　　　　　: Printed media (n = 140)

Figure 2. Sources of information based on age group and education level.

4. Discussion

As the main forest product, woods are utilized for different purposes, for instance roundwood for industrial purposes, pulp and paper, housing, and furniture material. [28]. Wood for building materials, furniture, and energy sources were considered to be commonly used in the Czech Republic [19]. Between the years 2000 and 2018, the Czech statistical office reported an increased trend (up to 15%) in wooden house/building constructions [29]. In this survey, 46.3% of the respondents reported that they considered wood a better material for housing than other materials, due to the short duration of material preparation, its environmentally friendly factor, the reasonable price, and its thermal insulating character. In contrast, wood's short lifespan and non-fireproof characteristics were in the bottom two of the reasons. Our results revealed that the strength and weakness of wood could either discourage or encourage customers to buy wood materials. By aiming to find solutions that could produce wood materials with a long lifespan, that are fireproof and sustainable at a reasonable price, wood consumption in the country can be improved. Additionally, the Czech statistical office also reported that utilization of wood as a furniture material (excluding kitchen furniture) in the country was similar over the years, especially 2017–2018 [30]. Our survey presented a preference for wood for furniture materials, which gives an opportunity for the development of value-added products in this sector, too. This can be seen also as a potential market for producers of the local wood furniture, with the caution of a potential change in consumption patterns from roundwood to, e.g., plywood furniture.

In 2015, the Czech statistical office reported that about 25% of utilized energy was from renewable resources. From 1995 to 2015, the trend of using energy from renewable resources nearly doubled. Use of renewable energy source was mostly at household levels (66.5%), followed by industry (25.2%) and other sectors (8.3%) [31]. Wood as a renewable energy resource was used by 38.6% of our respondents. Firewood was the most preferred type of wood as a source of energy. The results

imply that the simple use of wood as an energy source was still favourable. In this survey, we did not ask further questions regarding the respondents' reasons for selecting an energy source at home. About two million m^3 per capita of wood was used as a source of energy in the country, which was lower compared to the roughly twelve and six million m^3 users in Germany and Austria, respectively, indicating that it is challenging to change the practice of using a fossil-based heater to a wood boiler energy source.

Studies from Finland, Germany, and Austria reported growing economic activity in rural areas, which includes biomass-based value chains and the economic utilization of other types of FES [32–34]. In comparison to Austria and Germany (about 14,800 and 19,900 full-time equivalent (FTE), respectively), the country had 42,500 FTE employmen in forest-based sectors. However, the annual change rate of FTE decreased in the Czech Republic (− 6.85%) [35]. In the Czech Republic, the number of employees in the forestry sector has systematically decreased in the last two decades, mainly due to low wages in this sector. This mainly concerns workers, and started to manifest itself negatively in the last two years in connection with the bark beetle outbreak. There is a lack of staff both in logging activities (inability to remove infested trees within the legal deadline), and especially in planting activities (there are not enough workers to plant trees). Therefore, the promotion of production in the bioeconomy, and changing the consumption pattern of the Czech people in the future, could potentially improve the employment situation in the forest-based sector and its value chains. The new challenge is to launch a better use of biological renewable resources in the Czech Republic in a suitable form for the future of society in sustainable manner.

To date, only wood forest products are considered to provide significant economic value for the Czech forest owners. Through the adoption of the forest bioeconomy strategy, it is expected that other FESs will also be promoted. NWFPs, especially mushrooms and different varieties of berry, were important for the recreational activity and socio-economic value of the Czech public [36,37]. The Czech MoA [22] reported that mushrooms were the most picked NWFPs (21,900 kg per year), and, altogether, collected berries amounted to 17,000 kg per year. Our current study also found a similar trend in preferred NWFPs (mushrooms and berries), which suggests the importance of further promoting this FES. In this survey, we did not ask how the respondents obtained the NWFPs (e.g., self-picking or buying the berries, honey, etc.). However, we discovered the importance of the respondent's gender and their preferred NWFPs, with women preferring more diverse NWFPs than men, such as collecting forest flowers and honey. In Switzerland, women were also reported as potential consumers of NWFPs [38].

In contrast, hoof game meat seemed to be of more interest for males compared to females. The Czech statistical office reported that consumption of game meat was still considered to be low (1.2% from the total consumed meat per year per capita). Additionally, the statistical office also reported an increasing trend of game animal consumption, from 0.5 kg per capita per year in 2006 to 0.9 kg in 2013 [39]. Game animals, such as wild boars and deer, are raised more naturally than livestock on a farm. The potential increase in game meat consumption due to hunting activities could cause problems in the forest, such as damage to the growth of young shoots. Additionally, the argument surrounding the function of hunting game as a recreational activity (e.g., getting a trophy, as a type of sport) and wildlife management [40] is an ongoing discussion among associated stakeholders in the Czech Republic, in addition to the problem of too high a stock of hoofed game [22].

By visiting the forests, the people utilize the recreation services of the forests. Access to the Czech forest is a public right. At the moment, there are no official data regarding the frequency of the forest visits of the Czech general population. However, concerning mushroom and berry picking, 90% of Czech visitors visited the forests at least once a year, of which 20% visited on a weekly basis [36]. Our study reported that a very high proportion (99%) of respondents aged 18–65 years visited the forest at least once per year (Table 1), which was higher than the 90% of Czech forest visitors in 2005 [36]. The reason for this was probably due to the age range of our respondents, which was at a productive age, and not including those below 15 and above 65 years, who are less active and more

dependent. Meanwhile, 66.67% of the German general population went to forests at least once a year [17], while 40% of Austrians visited forests every week [41]. Out of the 99% of forest visitors in our survey, 77.1% of them visited the Czech forest frequently. However, detailed reasons for visiting the forest were not asked for in this survey. In another national survey (The Market & Media & Lifestyle), walking and doing sport were the largest drivers of the Czech forest visits [42]. By understanding the drivers of forest visits, programs concerning the promotion of FES could be well targeted and developed by the respective forest owners and enterprises.

Our results also revealed that the proportion of respondents that have graduated from secondary school/vocational training (46.7%) was significantly higher in the group of never or rarely visited the forests than other education levels ($p = 0.004$). Based on the results of binary logistic regression analysis, respondents that have graduated from secondary school/vocational training had a 1.6 times odds ratio of not visiting or rarely going to the forest ($p = 0.001$). The education plans of the secondary vocational schools involve more practical and physical work than regular high schools, which lead to more physical jobs and rotating work schedules (shift). In this study, we did not collect information on the type of occupation of the respondents. It was likely that the respondents who had graduated from the secondary school/vocational training had time constraints to do recreational activities due to the type of occupation (excluding those who graduated from a forestry or agriculture secondary vocational school).

In order to increase public awareness with regards to the adoption of a bioeconomy strategy, it is important to select an appropriate information provider, since changes in consumer behavior are expected. Respondents in this national survey still favoured TV and the peer group/family as major information channels. Online news and social media were the next most frequently selected information providers, especially for the respondents below 55 years old. We also found that gender influenced preferences in utilizing online news (male) or social media (female). The internet has been predicted to win over more traditional information providers [43]. But, since a high proportion of respondents in this survey selected TV as the source for information, therefore, TV should still be considered as an important channel, together with other selected mediums.

5. Conclusions and Recommendations

The results of the survey presented wood products as the most preferred material for furniture (96.3%) and building materials (46.3%). We found that 38.6% of Czech residents used wood as a source of energy, mostly in the form of firewood. It is challenging to change the practice of using fossil-based heaters to wood boiler energy sources. However, by addressing the positive attributes of wood and their impact on the future environment, it is likely that an increase in awareness and changes in consumer patterns can be expected. As the country has not yet adopted a bioeconomy strategy, a review study on the forest bioeconomy in other European countries is recommended, in order to give a better understanding of the impacts of bioeconomy strategies on a country's economic growth, particularly in the forest-based sector. The promotion of wood and non-wood forest products is encouraged, starting with increasing awareness and knowledge of the strength of the forest-based sector as a renewable energy resource and the importance of forest ecosystem services for recreation, health, and the well-being of the people. The increasing trends in NWFPs' utilization can be further promoted by creating different events in relation to respective FESs, while being careful to regulate the sustainable and shared responsibility aspects of protecting the forest. We also propose to investigate the reasons for visiting the forest and design a targeted program for a specific population (based on age, education level, type of occupation, or gender) in the country. It is important to utilize all channels as an information source for the importance of FES and the bioeconomy, depending on the target groups. We also propose to include forestry extension programs at school, especially in secondary vocational schools, aiming to inform people about and link people with forests, and to improve their participation in safeguarding the environment.

References

1. European Commission. *Innovating for Sustainable Growth: A Bioeconomy for Europe*; European Commission: Brussels, Belgium, 2012; p. 16. ISBN 978-92-79-25376-8.
2. European Commission. *A Sustainable Bioeconomy for Europe: Strengthening the Connection between Economy, Society and the Environment. Updated Bioeconomy Strategy*; European Commission: Brussels, Belgium, 2018; p. 4. ISBN 978-92-79-94144-3.
3. Winkel, G. Introduction. In *Towards a Sustainable European Forest-Based Bioeconomy. Assessment and the Way forward. Winkel, G. Ed.*; European Forest Insitute: Joensuu, Finland, 2017; pp. 15–18. ISBN 978-952-5980-42-4.
4. Glück, P. Social Values in Forestry-Synopsis. *Ambio* **1987**, *16*, 158–160. Available online: https://www.jstor.org/stable/4313346?seq=1 (accessed on 3 May 2019).
5. Giurca, A.; Späth, P. A Forest-Based Bioeconomy for Germany? Strengths, Weaknesses and Policy Options for Lignocellulosic Biorefineries. *J. Clean. Prod.* **2017**, *153*, 51–62. [CrossRef]
6. Millennium Ecosystem Assessment. *Ecosystems and Human Well-Being: Synthesis*; Island Press: Washington, DC, USA, 2005; p. VI. ISBN 1-59726-040-1.
7. Nowak, D.; Noble, M.H.; Sisinni, S.M.; Dwyer, J.F. People and Trees: Assessing the US Urban Forest Resource. *J. For. Res.* **2001**, *99*, 37–42.
8. Krieger, D. *Economic Value of Forest Ecosystem Services: A Review*; The Wilderness Society: Washington, DC, USA, 2001; pp. 1–31.
9. Millennium Ecosystem Assessment. *Ecosystems and Human Wellbeing: Opportunities and Challenges for Business and Industry*; World Resources Institute: Washington, DC, 2005; pp. 3–5.
10. Pettenella, D.; Secco, L.; Maso, D. NWFP&S Marketing: Lessons Learned and New Development Paths from Case Studies in Some European Countries. *Small-scale For.* **2007**, *6*, 373–390.
11. Nijnik, M.; Nijnik, A.; Brown, I. Exploring the Linkages between Multi-Functional Forestry Goals and the Legacy of Spruce Plantations in Scotland. *Can. J. For. Res.* **2016**, *46*, 1247–1254. [CrossRef]
12. Grêt-Regamey, A.; Altwegg, J.; Sirén, E.; van Strien, M.; Weibel, B. Integrating Ecosystem Services into Spatial Planning-A Spatial Decision Support Tool. *Landsc. Urban Plan.* **2016**, *165*, 206–219. [CrossRef]
13. de Arano, I.M.; Muys, B.; Topi, C.; Petenella, D.; Feliciano, D.M.S.; Rigolot, E.; Lefevre, F.; Prokofieva, I.; Labidi, J.; Carnus, J.M.; et al. *A Forest-Based Circular Bioeconomy for Southern Europe: Visions, Opportunities and Challenges. Reflections on the Bioeconomy*; European Forest Institute: Joensuu, Finland, 2018; pp. 1–119.
14. Marusakova, L.; Sallmannshofer, M.; Kaspar, J.; Schwarz, M.; Tyrvainen, L.; Bauer, N. Human Health and Sustainable Forest Management. In *Human Health and Sustainable Forest Management*; Marusakova, L., Sallmannshofer, M., Eds.; Forest Europe—Liaison Unit Bratislava: Zvolen, Slovakia, 2019; pp. 58–97. ISBN 978-80-8093-266-4.
15. Eurostat-European Commission. Agriculture, fishery and forestry statistics, Main results—2010-11. 2012. Available online: https://ec.europa.eu/eurostat/documents/3930297/5967972/KS-FK-12-001-EN.PDF/0de35d0b-aad0-4cfa-9319-c30f05d46ace (accessed on 10 January 2020).
16. Ministry of Agriculture of the Czech Republic. *National Forest Programme for the Period until 2013*; Ministry of Agriculture of the Czech Republic: Praha, Czech Republic, 2008; p. 7. ISBN 978-80-7084-758-9.

17. Federal Ministry of Food, Agriculture and Consumer Protection (Bundesministerium für Ernährung, Landwirtschaft und Verbraucherschutz/BMELV). *Forest Strategy 2020 Sustainable Forest Management—And Opportunity and Challenge for Society*. Available online: https://www.bmel.de/SharedDocs/Downloads/EN/ Publications/ForestStrategy2020.pdf?__blob=publicationFile (accessed on 3 May 2019).

18. Federal Ministry for Sustainability and Tourism. *Austrian Forest Strategy 2020+*; Federal Ministry for Sustainability and Tourism: Wien, Austria, 2018; p. 46.

19. Ministry of Agriculture of the Czech Republic (MoA). Information on Forests and Forestry in The Czech Republic by 2017. Available online: http://eagri.cz/public/web/file/615927/Zprava_o_stavu_lesa_2017_ENG. pdf (accessed on 10 October 2019).

20. Eurostat-European Commission. Forestry statistics in detail. Statistics Explained. Available online: https://ec.europa.eu/eurostat/statistics-explained/pdfscache/29576.pdf (accessed on 10 May 2019).

21. FAO. Global Forest Products Facts and Figures 2016. Available online: http://www.fao.org/3/i7034en/i7034en. pdf (accessed on 3 May 2019).

22. Ministry of Agriculture of the Czech Republic (MoA). Information on Forests and Forestry in The Czech Republic by 2012. Available online: http://eagri.cz/public/web/file/272639/ZZ_2012_ENG.pdf (accessed on 10 January 2020).

23. Gruber, J.; Milligan, K.; Wise, D. *Social Security Programs and Retirement Around the World: The Relationship to Youth Employment, Introduction and Summary*; NBER Working Papers; National Bureau of Economic Research, Inc., 2009; no. wp. 14647; Available online: https://doi.org/10.3386/w14647 (accessed on 10 October 2019).

24. Chomik, R.; Piggott, J. Mature-age labour force participation: Trends, barriers, incentives, and future potential. Available online: http://cepar.edu.au/sites/default/files/Mature-age_labour_force_participation.pdf (accessed on 10 October 2019).

25. Czech Statistical Office. Population Statistics Department (Kde a jak bydlí české domácnosti?). Available online: https://www.czso.cz/csu/czso/kde-a-jak-bydli-ceske-domacnosti-p2eqbgktkl (accessed on 11 November 2019).

26. Czech Statistical Office. Population Statistics Department. Educational Level of Population According to Census Results. Available online: https://www.czso.cz/documents/10180/20536250/17023214.pdf/7545a15a- 8565-458b-b4e3-e8bf43255b12?version=1.1 (accessed on 9 November 2019).

27. Dembner, S.A.; Perlis, A. Towards a Harmonized Definition of Non-Wood Forest Products. *Unasylva* **1999**. Issue No. 198. Available online: http://www.fao.org/3/x2450e/x2450e0d.htm#fao%20forestry (accessed on 9 January 2020).

28. FAO; UNECE. Forest Products Annual Market Review 2017–2018. Available online: https://www.unece.org/ fileadmin/DAM/timber/publications/FPAMR2018.pdf (accessed on 11 November 2019).

29. Czech Statistical Office. Press Release - Building Construction Has Been Successful in Recent Years (Stavebnictví Se v Posledních Letech Daří). Available online: https://www.czso.cz/csu/czso/stavebnictvi-se- v-poslednich-letech-dari (accessed on 12 December 2019).

30. Czech Statistical Office. Manufacture of Selected Products from Industry - 2018 (Výroba Vybraných Výrobků v Průmyslu - 2018). Available online: https://www.czso.cz/csu/czso/vyroba-vybranych-vyrobku-v-prumyslu- 2018 (accessed on 12 December 2019).

31. Czech Statistical Office. Fuel and Energy Consumption in Households. Department of Industry, Construction and Energy Statistics (Spotřeba Paliv a Energií v Domácnostech). Available online: https://www.czso.cz/documents/10180/50619982/ENERGO_2015.pdf/86331734-a917-438a-b3c2- 43a5414083fc?version=1.4 (accessed on 12 December 2019).

32. Finnish Environment Institute. Finnish Environment Institute Reports 13 | 2017. Renewal of forest based manufacturing towards a sustainable circular bioeconomy. 2017. Available online: https://pdfs. semanticscholar.org/c5e9/20375fde67380d02f152a505f01352768931.pdf (accessed on 13 December 2019).

33. Biobased Industries Consortium. Bioeconomy Regions in Europe. 2017. Available online: https://biconsortium.eu/sites/biconsortium.eu/files/publications/BIC_GA_Brochure_Bioeconomy_ regions_in_Europe_Nov_2017.pdf (accessed on 9 January 2020).

34. BIOPRO. Country Report. Cross-Clustering Partnership for Boosting Eco-Innovation by Developing a Joint Bio-Based Value-Added Network for the Danube Region. Framework Conditions for Cluster Development in Bio-Based Industry in the Region of Baden-Württemberg, Germany. 2018. Available online: http://www.ipe.ro/Country%20Report%20Baden%20W.pdf (accessed on 5 December 2019).

35. FAO. Global Forest Resources Assessment 2015: Desk Reference. Rome. 2017. Available online: http://www.fao.org/forest-resources-assessment/past-assessments/fra-2015/en/ (accessed on 5 December 2019).

36. Šišák, L. Importance of Non-Wood Forest Product Collection and Use for Inhabitants in the Czech Republic. *J. For. Sci.* **2006**, *52*, 417–426. [CrossRef]

37. Šišák, L.; Riedl, M.; Dudik, R. Non-Market Non-Timber Forest Products in the Czech Republic-Their Socio-Economic Effects and Trends in Forest Land Use. *Land Use Policy* **2016**, *50*, 390–398. [CrossRef]

38. Seeland, K.; Kilchling, P.; Hansmann, R. Urban Consumers' Attitudes Towards Non-Wood Forest Products and Services in Switzerland and an Assessment of Their Market Potential. *Small-scale For.* **2007**, *6*, 443–452. [CrossRef]

39. Czech Statistical office (CZSO). Consumption of Food and Non-Alcoholic Beverages (Annual Per Capita Averages). 2015. Available online: https://www.czso.cz/documents/10180/20562003/2701391501.pdf/1547f1b0-eeac-482f-8ea0-2289d3b4ed3e?version=1.1 (accessed on 25 November 2019).

40. Fischer, A.; Sandström, C.; Delibes-Mateos, M.; Arroyo, B.; Tadie, D.; Randall, D.; Hailu, F.; Lowassa, A.; Msuha, M.; Kereži, V.; et al. On the Multifunctionality of Hunting—An Institutional Analysis of Eight Cases from Europe and Africa. *J. Environ. Plan. Manag.* **2013**, *56*, 531–552. [CrossRef]

41. Federal Ministry for Agriculture, Forestry Environment and Water Management. *Forest in Austria*; Federal Research Centre for Forests, Natural Hazards and Landscape: Vienna, Austria, 2017; p. 24. ISBN 978-3-902762-73-3.

42. Šodková, M.; Purwestri, R.C.; Riedl, M.; Jarský, V.; Hájek, M. What Drives the Forest Visit? Results of a National Survey in Czech Republic. unpublished work, manuscript in preparation. 2020.

43. Havick, J. The Impact of the Internet on a Television-Based Society. *Technol. Soc.* **2000**, *22*, 273–287. [CrossRef]