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Understanding societal priorities for forest ecosystem services: Survey insights from 'Forestry Days 2024' in Slovakia

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Abstract: Understanding society's demand for forest ecosystem services (FES) is crucial for effective forest management and the development of supportive instruments, such as payments for ecosystem services (PES). This study surveyed visitors at 'Forestry Days 2024' in Slovakia through face-to-face questionnaires, capturing their views on FES and necessary management changes. Results show that regulating services and biodiversity are prioritised over cultural and provisioning FES. Respondents indicated a clear need for changes in forest management to reflect their FES preferences. Notably, perceptions of specific FES varied by gender, age, forestry background, and forest ownership but not by residence type. Public PES were considered the most acceptable policy for enhancing FES management, providing valuable insight for aligning public preferences with sustainable practices in Slovakia.

Keywords: biodiversity; payments for ecosystem services; preferences; regulatory services

Ecosystems provide various ecosystem services (ES) vital to environmental health and human well-being. ES are classified into specific categories (Millennium Ecosystem Assessment 2005; Kumar 2010; Haines-Young, Potschin-Young 2012). Its hierarchical structure allows the identification of various levels of ES in detail, despite the fact that different classification systems are not always comparable (Van der Wilde, Newell 2021). Forest ecosystem services (FES) include provisioning services like timber and non-timber forest products, regulating carbon sequestration and water purification, cultural services offering recreational and spiritual benefits, and supporting services like biodiversity conservation. Understanding and managing these diverse FES is essential for sustainable forest man-

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agement (SFM) (Kumar 2010; Mengist, Soromessa 2019; Forest Europe 2020).

The various societal and political demands for FES define the forest management objectives for public and private forests (De Groot et al. 2010; Winkler et al. 2022). Payments for Ecosystem Services (PES) are a globally known market-based mechanism to incentivise forest conservation and sustainable management and FES support (Wunder et al. 2020). Understanding public priorities for FES and their support for PES is crucial for effective implementation. This research contributes to the ongoing discourse on the significance of forest ecosystem services and the need for accurate policy tools to support them. It also reflects the increasing pressure across European regions to prioritise non-provisioning ecosystem services and biodiversity conservation in forest management.

The primary goal of this research is to explore the public's perception of the importance of FES and to identify the social variables that influence them. Several key research questions guide this study: (*i*) Are there differences in the perceived importance of FES among respondents? (*ii*) Is there a link between selected social variables and the prioritisation of certain FES? (*iii*) Is there support from participants in implementing PES schemes in Slovakia? An additional goal of this work was to assess how effectively the FES approach can be communicated to the public, ensuring a broader understanding and support for SFM practices.

MATERIAL AND METHODS

Sample method. In the first stage, we applied convenience sampling during the annual thematic event called 'Forestry Days', organised nationwide to inform about the importance of forests for society. The second stage was a random sampling of adult visitors attending the 18th anniversary of the open-air event in the city of Zvolen (central Slovakia) on April 19th, 2024. We conducted direct face-to-face interviews using structured questionnaires. The survey included 139 valid responses.

Questionnaire design. To determine the clarity of the questions for respondents, the questionnaire design followed the structure used in a previous project (Sarvašová et al. 2021). The questionnaire was divided into three main parts. After the introductory ice-breaking question about visiting the forest in respondents' leisure time, questions were aimed at:

– the importance of forests and forest ecosystem services;
– opinion on forest management and PES;
– respondents' background information.

We refer to the list of ES defined by the Millennium Ecosystem Assessment (2005) and Mederly et al. (2019). We used 18 ES, which can be perceived and valued differently regarding the forestry sector, or the population needs. Considering economic and lifestyle circumstances in Slovakia, we added or renamed some items to ensure that the questionnaire design and statements were straightforward to answer. FES categories followed previous surveys and expert knowledge (Sarvašová et al. 2014; Šálka, Sarvašová 2023). During the survey, we discussed the questionnaire content with the respondents in person. Provisioning FES were expressed as benefits represented in wood (timber, biomass for energy, fuel wood) and non-wood products (game and trophies, drinking water, mushrooms, and berries); regulating FES was described as protection against natural disasters, soil conservation, carbon sequestration, air purification, climate regulation, and water resource conservation; and cultural FES incorporated aesthetic, spiritual, historical, and educational values. Additionally, we asked about biodiversity conservation as supporting ES and the importance of forests for job and income opportunities.

The Likert three-point scale was used to determine the importance of the 16 listed FES at the levels: 1 – low importance, 2 – medium importance, and 3 – high importance. The answers to questions about the change in forest management were only at two levels: 0 – no, and 1 – yes.

The last part was devoted to respondents' background information. Consequently, the answers were divided into several groups according to leisure time use (in my leisure time, I go to the forest; in my leisure time, I don't go to the forest), forestry education, forest ownership, residence (living in the city, living in the countryside), age, and gender.

Analysis. First, descriptive statistics was used to understand the respondents' backgrounds and the percentage distribution of the importance of the FES.

Second, the importance of the validity and reliability of the FES was analysed using one-factor analysis of variance with the Statistica software

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(Version 14, 2020). The following methods of data analysis were used:

(*i*) Descriptive statistics frequency tables were used to see the distributions of the respondents' answers. Nominal variables are presented as percentages and frequencies. The mean (*M*) was used from the positional characteristics of the data.

(*ii*) ANOVA, a one-factor analysis of variance, was used to examine the dependence of answers on ES importance on social variables (e.g. demographic factors).

These tests are used to test hypotheses that there is a statistical influence between variables.

The basic statistic computed in the analysis of variance is the *F*-test criterion.

The total variance can be divided into two components: (*i*) 'within-group' (variance around the group mean); (*ii*) 'between-group' (i.e. the variance of group means around a shared, overall mean of all group means).

Statistically reliable is considered when $P < 0.05$. For the so-called multicomparative test, which shows the statistical significance of individual differences in means for all possible pairs of comparison groups (e.g. gender), we used Tukey's test. Statistically significant differences were determined at the $\alpha = 0.05$ level.

RESULTS

Basic information about respondents. Altogether, 139 valid questionnaires were evaluated. We focused on assessing the results within each category of responses (Table 1). Most respondents answered that they did go to the forest (> 90%), they were mostly female (> 56%), were younger than 50 years (> 70%), did not have forestry education (> 76%), were not forest owners (> 79%), and lived in towns (> 67%).

Importance of forest ecosystem services. The levels of FES importance are presented in Table 2. Provisioning FES were represented by ES 1, ES 2, ES 3, ES 8, and ES 11 (FES group P), regulatory by ES 4, ES 9, ES 10, and ES 13 (FES group R), cultural by ES 5, ES 6, ES 14, and ES 15 (FES group C). ES 12 represents biodiversity (FES group B), and ES 7 illustrates the importance of forests in the rural economy (FES group E).

Figure 1 presents the average values of all FES evaluations. The importance of some FES was evaluated, in general, higher than that of others.

Tukey's test showed that only two of the five FES groups were homogeneous (Table 3). Regulatory FES were evaluated highly, along with biodiversity conservation (group A). All the others were separate groups (groups B, C, D). This is followed by cultural FES, provisioning FES, and the less-critically evaluated economic benefits from forests and job opportunities.

Regarding the importance of FES, we focused on assessing the differences in reactions within each category (factor). Differences in responses are presented in Table 4. We found significant differences in five categories ($P < 0.05$).

The categories of gender and age had the most considerable differences. Males answered sta-

Table 1. Share of responses by categories

Category	Answer/factor	Share of responses (%)
Leisure time	I go to the forest	90.65
	I don't go to the forest	9.35
Gender	female	56.93
	male	43.07
Age	under 50 years	70.07
	51+ years	29.93
Background in forestry	forestry education	23.36
	no forestry education	76.64
Forest owner	yes	20.44
	no	79.56
Residence	urban	67.88
	rural	32.12

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Table 2. Evaluation of forest ecosystem services (FES) importance in % of responses

FES	FES group	The importance of forests as a …	1 – low	2 – medium	3 – high
ES 1	P	source of wood raw material and biomass	11.51	35.25	53.24
ES 2	P	source of game and hunting trophies	41.01	36.69	22.30
ES 3	P	source of firewood	15.11	46.04	38.85
ES 4	R	protection against natural disasters	0.72	6.47	92.81
ES 5	C	space for recreation, sports, and health promotion	2.16	23.02	74.82
ES 6	C	protection against stress and diseases	5.76	12.95	81.29
ES 7	E	source of employment and income	20.86	44.60	34.53
ES 8	P	source of drinking water	2.88	15.83	81.29
ES 9	R	source of clean air (purification)	0.72	5.04	94.24
ES 10	R	protection against dust, imissions, noise	2.16	15.11	82.73
ES 11	P	source of forest fruits (mushrooms, berries, herbs)	7.91	43.88	48.20
ES 12	B	space for a diversity of flora and fauna	1.44	16.55	82.01
ES 13	R	protection against climatic extremes	1.44	8.63	89.93
ES 14	C	part of cultural heritage and history	7.91	32.37	59.71
ES 15	C	space for education and learning about nature and the landscape	4.32	25.90	69.78
ES 16	C	source of aesthetic and spiritual experiences	15.11	34.53	50.36

ES – ecosystem services; B – biodiversity; C – cultural; E – economy; P – provisioning; R – regulation

tistically significantly differently than females in 4 of the 16 questions, and respondents under 50 answered differently in up to 4 questions compared to respondents over 50. Three statistically significantly different responses were recorded for the leisure, background in forestry, and forest ownership categories. No statistically significant difference was observed in the category of residence. Regard-

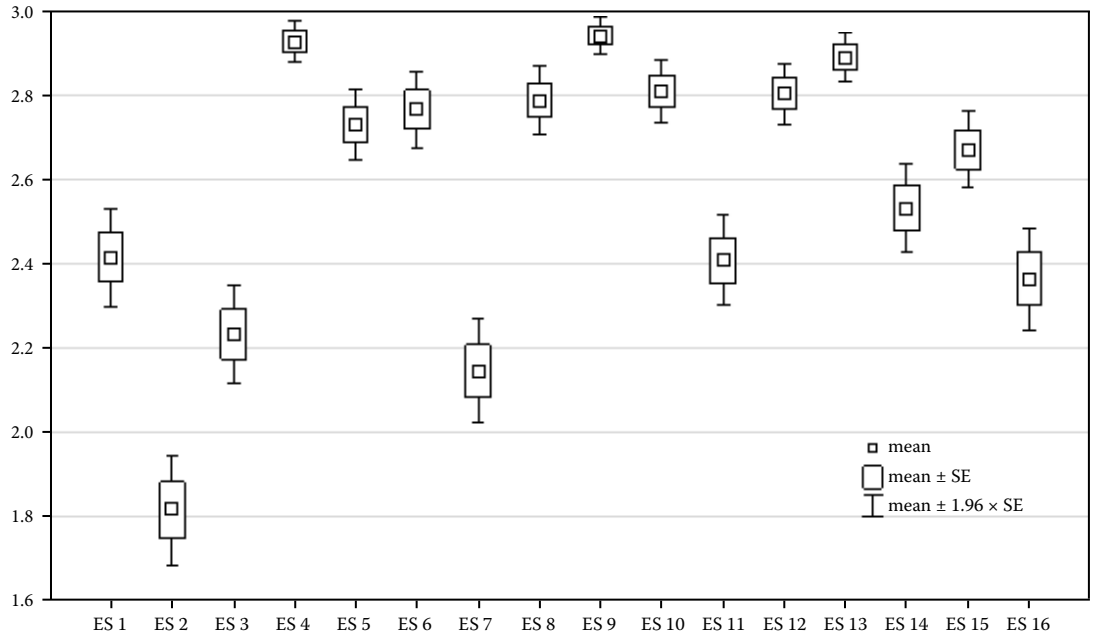

Figure 1. Evaluation of the importance of forest ecosystem services (FES)

ES – ecosystem services; SE – standard error

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Table 3. Homogeneity of forest ecosystem services (FES) groups

Group of FES	Mean	Homogeneity test			
Regulatory	2.892336	A	–	–	–
Biodiversity	2.802920	A	–	–	–
Cultural	2.613139	–	–	–	D
Provisioning	2.332847	–	–	C	–
Economic benefits	2.145985	–	B	–	–

A, B, C, D – the homogenity groups

ing responses to each question, it suggests that the importance of FES from the perspective of urban and rural inhabitants is the same.

The most varied responses were in the evaluation of the first three FES. For ES 1 there were statistically significantly different answers in up to four categories. ES 2 (wood raw material and biomass) was highlighted by men, people over 50, people with forestry education, and forest owners. ES 3 (fuel wood) was answered differently in 3 categories. The high importance of the forest as a firewood source is seen by men, people over 50 years of age, and forest owners. For question 2 (game and hunting) responses differed in 2 categories (gender, age), where the importance is considered high by men and people over 50.

People visiting forests highly evaluated questions related to cultural and recreational values (ES 5, ES 6, and ES 14). The higher value of forests as a source of employment and income (ES 7) was recognised by people with a background in forestry. Significant differences have also been evaluated in ES 15 (space for education and learning) by forest owners. Women attribute ES 12 (biodiversity) significantly higher than men. Age is a decisive category in the perception of the importance of the purification function of forests (ES 9) and the aesthetic and spiritual values of forests (ES 16). Forests as a source of clean air have higher importance for people under 50 years, and people above 51 highly appreciate forests' aesthetic and spiritual values.

Requests to change forest management and possible payment schemes. Figure 2 presents the answers to the required changes in current forest management to secure the preferred FES. According to 61.3% of respondents, a change in current practical forest management is needed in line with the FES priorities. Only people who did not visit forests answered the opposite (53.8%).

Table 4. Differences in the importance of forest ecosystem services (FES) by category

FES	Leisure		Gender		Age		Background		Ownership	
	P	*F*	*P*	*F*	*P*	*F*	*P*	*F*	*P*	*F*
ES 1	0.313	1.027	0.018*	5.734*	0.016*	6.011*	< 0.001*	15.086*	< 0.001*	15.817*
ES 2	0.083	3.048	< 0.001*	13.314*	0.006*	7.957*	0.130	2.316	0.265	1.253
ES 3	0.398	0.719	< 0.001*	11.452*	0.239	1.396	0.013*	6.295*	0.010*	6.850*
ES 4	0.289	1.134	0.679	0.172	0.516	0.424	0.815	0.055	0.133	2.284
ES 5	0.007*	7.388*	0.500	0.457	0.269	1.231	0.580	0.308	0.296	1.100
ES 6	0.006*	7.759*	0.474	0.516	0.841	0.041	0.843	0.039	0.169	1.910
ES 7	0.452	0.568	0.206	1.615	0.309	1.044	0.004*	8.544*	0.793	0.069
ES 8	0.170	1.906	0.104	2.676	0.791	0.070	0.924	0.009	0.393	0.733
ES 9	0.405	0.697	0.313	1.027	0.011*	6.728*	0.390	0.743	0.058	3.652
ES 10	0.729	0.120	0.280	1.177	0.612	0.258	0.075	3.211	0.746	0.105
ES 11	0.130	2.326	0.266	1.247	0.513	0.430	0.511	0.434	0.418	0.661
ES 12	0.102	2.709	0.032*	4.673*	0.973	0.001	0.887	0.020	0.472	0.520
ES 13	0.731	0.119	0.221	1.511	0.439	0.603	0.777	0.080	0.969	0.002
ES 14	0.022*	5.352*	0.507	0.443	0.128	2.347	0.330	0.954	0.189	1.743
ES 15	0.356	0.859	0.074	3.232	0.873	0.026	0.357	0.853	0.023*	5.272*
ES 16	0.133	2.280	0.717	0.132	0.009*	6.936*	0.194	1.701	0.220	1.520

*significant at $P < 0.05$; ES – ecosystem services; *F* – mean square treatment/mean square error [the *F*-value (*F*-statistic) is the ratio between the mean square deviation between groups (*MST*) and the mean square deviation within groups (*MSE*)]

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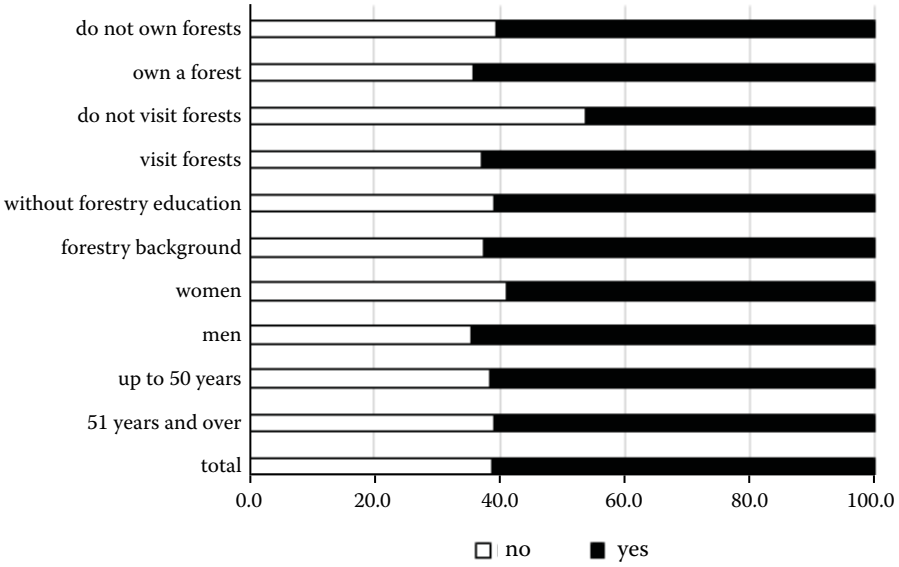

Figure 2. Answers in %: Does forest management need to change to secure your preferences?

Most of those who answered positively (83.45%) think that forest owners or managers should be paid to change management according to society's priorities (Figure 3).

Any of the categories investigated, such as gender, age, background in forestry, ownership of forests, or type of residence, had significant differences in changing management and opinion on the necessity of payments for FES.

More than half of those favouring PES (52.6%) preferred public PES, such as incentives and compensations from the state budget or European funds. Private PES based on the principle 'who uses the forest or asks for a change in management should pay for it' was the second most common answer (28.1%). The option of a special fee or tax for all inhabitants of Slovakia, including the forest management costs of ensuring water quality in sewerage charges, was selected by 13.16% of respondents. The possibility that every individual who goes into the forest for a walk or to pick mushrooms should pay was the least prioritised payment option among the respondents (6.1%). Surprisingly, this option was not a priority, even for people who did not go to the forest during their leisure time (0%) (Figure 4).

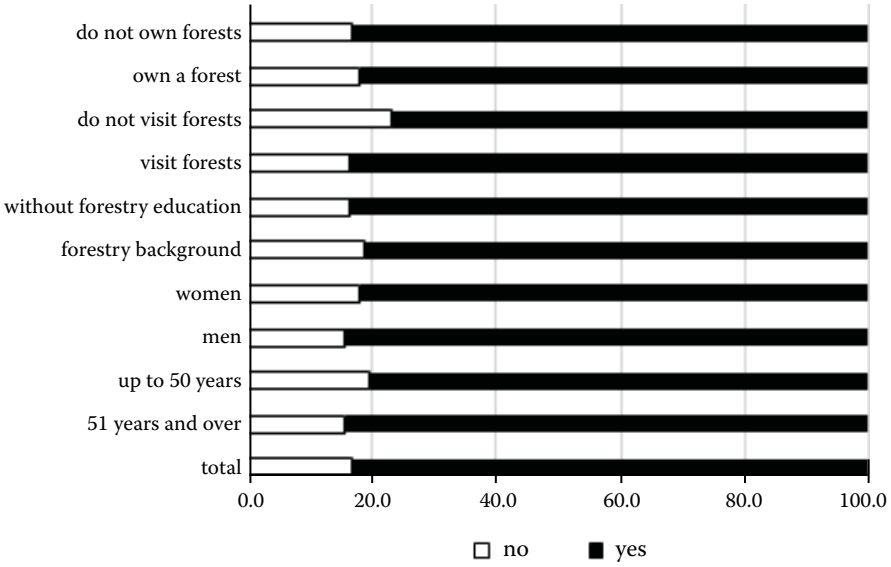

Figure 3. Answers in %: Does a forest manager get paid to change management according to company priorities?

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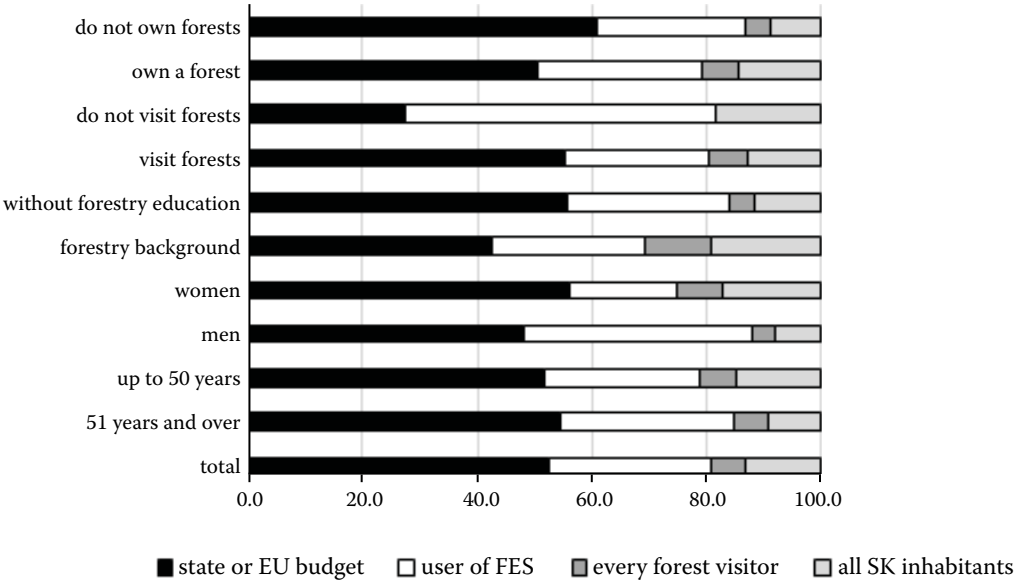

Figure 4. Answers in %: Who should pay a forest manager to change management according to society's priorities?

DISCUSSION

Our research, as with most studies, was focused on citizens' preferences regarding FES (e.g. Blundo-Canto et al. 2018; Schutter et al. 2021; Bruzzese et al. 2022). We focused on determining the value that citizens assign to the individual FES to examine what factors influence their preferences for PES where forest management is needed. This study found that Slovak people prioritise regulating, cultural, and provisioning FES, as in other studies (Lin et al. 2021; Paluš et al. 2021; Bruzzese et al. 2022; Louda et al. 2023; Marcineková et al. 2024). Cultural FES gained importance, mainly due to the COVID-19 pandemic (Beckmann-Wübbelt et al. 2021; Jarský et al. 2022).

Provisioning FES are generally less favoured, while biodiversity conservation is rated the highest. The importance of wood production is neglected, hunting activities relate to negative connotations, and the production of trophies and venison is the least essential FES. Nevertheless, people believe that for the maintenance and support of FES, forest management needs to change. These findings are well in line with other studies on social perceptions towards forests (e.g. Paletto et al. 2014; Puelzl et al. 2021) and on ES demand (Crivellaro et al. 2021; Ranacher et al. 2021), as well as with broader EU studies, such as Winkel et al. (2022) and Mann et al. (2022).

Public demands for FES change in forest management might lead to income losses or additional expenses for forest owners. This opens the possibility for the adoption of policy instrument mixes (Bouwma et al. 2018; Winkel et al. 2022; Fischer et al. 2023), including financial incentives (Bálikova, Šálka 2022), market-based instruments (Anderson et al. 2010), carbon credits (Sotirov et al. 2021) or Common Agricultural Policy environmental and Natura 2000 payments (Sarvašová et al. 2019).

In Slovakia, publicly funded schemes are the preferred PES mechanisms by the public and stakeholders (Báliková, Šálka 2022; Báliková et al. 2021, 2024), same as in our survey.

To incorporate stakeholder preferences and public attitudes into forest management decisions, reduce conflicts among forest users, and ensure successful formulation and implementation of plans, relevant surveys on society's demand for FES are even more critical (Bennett, Gosnell 2015). This research showed that social variables significantly impact the perception of the importance of FES. However, we still cannot explain the choice and motivation behind these behaviours due to a lack of empirical data. In terms of residence, this research did not find the significance of location reflecting the needs of residents in different regions for FES; it may be necessary to explore further the distance between the residence and the forest or the frequency of the actual use of the forest in the future.

One limitation of the study is the sampling procedure. We did not apply a representative sample

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for the selection of respondents; therefore, broader conclusions should be drawn cautiously. Given this fact, the observed structure of respondents may differ from the general population. For example, 68% of our respondents live in urban areas, while in the whole population in general it is 45%. Regarding the age groups, 70% of our respondents were under 50 years, whereas in the general population, this cohort represents 63% (Statistical Office of the Slovak Republic 2024). The division into two age categories (under 50 and over 50) was related to the sampling choice and followed the socially accepted margin between the junior and senior age. This study did not use the national population as a sampling source, but despite this fact, the results obtained can provide critical information for policymaking. In the future, when formulating public strategies and policy instruments, relevant policymakers can start by introducing PES and focusing on regulatory FES.

CONCLUSION

Our study revealed that respondents favour regulatory FES and biodiversity conservation. Provisioning FES and economic benefits from forests and job opportunities were rated less important. To secure the provision of prioritised FES, respondents acknowledged the need to change current management practices, granting forest owners or managers the right to be paid for this change in PES. Preferred financial instruments are public PES, followed by private PES. The least prioritised option was the fee for visiting forests. The results highlight demographic factors like gender, age, forestry education, and forest ownership, significantly affecting how individuals perceive the importance of FES. The insights gained from this study are vital for further policies and communication strategies development on the national scale in mitigating conflicts in forest management and informing policy.

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