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Structural analysis of the drivers and barriers to forest management in the Slovak regions of Podpoľanie and Kysuce

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Abstract
The paper presents an application of structural analysis in search of key drivers and barriers of forest management in two Slovak regions: Podpoľanie and Kysuce. A comparison with factors identified in selected European regions is also presented. First, various relevant factors affecting forest management were selected for both regions. The selections draw on the pool of primary data (structured in-person interviews) and secondary data (qualitative analysis of national and European documents). Second, factors were grouped according to the STEEP categories (Society, Technology, Economy, Ecology, and Policy). Subsequently, factors were rigorously assessed by the regional stakeholders in participatory workshops, and their answers were analysed by structural analysis with the help of Parmenides EIDOS™ software. The results show that in both Slovak regions political, economic, and ecological factors dominated over social and technological factors. The comparison with selected European regions revealed that in the Slovak and other European regions, the Policy category dominated due to having the highest number of factors and their overall impact on forest management. In contrast, the least important societal domain was Technology in both the Slovak and other European regions. However, while stakeholders across the selected European regions perceived the Society domain as significant, stakeholders in both Slovak regions perceived the Economy and Ecology domains as more significant.

Key words: STEEP categories; regional stakeholders; participatory approach; forest management

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1. Introduction

To address the challenges of diverse demands for ecosystem services in a future Europe requires a better knowledge of the drivers and barriers that forest management faces across various regions. These drivers and barriers influence the decisions made by forest owners, managers, and other stakeholders, which result in various approaches to forest management and the allocation of various ecosystem services (Brodrechtová et al. 2016). Knowledge of key influences and their interplay is crucial, as they play an important role in establishing consistent narratives and models for future developments in forest management in Europe (Sotirov et al. 2014). For instance, while almost a quarter of its area is either under EU and/or national nature conservation, in terms of forest management aims the provisioning services remain still crucial (Sotirov & Deuffic 2015; Brodrechtová et al. 2016). In this respect, a deeper understanding of forest management's key drivers and barriers can help eliminate existing discrepancies between social perspectives and demands that are reflected in incoherent policy aims, inconsistent instruments, and management approaches for the conservation and sustainable management of forests across Europe (e.g. Volz 2006; Adams & Jeanrenaud 2008; Adams 2009; Arnouts & Arts 2009; Winkel et al. 2009). Moreover, as the implications of various drivers and barriers directly influence different forest management strategies, more emphasis should be placed on local context next to national and European levels (Sotirov et al. 2014; Sotirov & Deuffic 2015; Brodrechtová et al. 2016).

So far, these challenges of various drivers and barriers of forest management from the local perspective have not been addressed in European research (Sotirov & Deuffic 2015). The attempt has been done within an interdisciplinary INTEGRAL project[1]. Drawing on various schools of thought (e.g., the Advocacy Coalition Framework adapted after Sabatier & Weible 2007, the Policy Arrangement Approach adapted after Arts et al. 2006) or on politicized Institutional Analysis and Development Framework (Ostrom 2005, 2007; Clement 2010) in the case of Slovakia (Brodrechtová et al. 2016), a broad set of ecological, social, economic, technological, and political factors across local, national, and European levels has been derived. Although all these factors might be important to forest management in the future, it has not been clear which factors are the key drivers and barriers to forest management. The goal of this study is therefore twofold: first, to look at selected Slovak regions and to identify the key factors and main societal domains affecting forest management in these regions; and second, to compare the results with factors identified in selected regions across Europe that are invol-

[1] INTEGRAL project – Future oriented integrated management of European forest landscapes – FP-7 project.

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ved in the INTEGRAL project. The selected European regions differ in their basic biophysical conditions and socio-economic circumstances related to forest management and conservation (Table 1).

The views of forest managers, owners, and other stakeholders from each region in Slovakia as well as across Europe are grasped via participatory workshops and with the use of the future-oriented research method called structural analysis. The workshops are used as they enable to test scientific knowledge against the practical knowledge of forest managers, owners, and other stakeholders. Moreover, public participation in sustainable forestry may help to develop better informed and more widely accepted forest management outcomes (Sarvašová 2014). The structural analysis is method that can be applied within participatory workshops as it produces visible results in a time-span of a few hours. This method simulates the decision processes of policymakers, other actors, or consumers in choosing among alternatives. It allows studying relationships in order to identify the influential and dependent domain drivers, and it also enables domain participants to find a method to share ideas, and to express their views and thinking about a specific problem (Glenn & Gordon 2005).

In this study, the systematic analysis is demonstrated in the Slovak regions of Podpoľanie and Kysuce. The results are compared with factors identified in other European regions (Table 1). The differences and similarities found in the social, cultural, economic, and ecological contexts of forest management in Europe can generally support development of coherent policy, economic frameworks, and consistent policy instruments.

2. Material and Methods

2.1. Characteristics of INTEGRAL regions

The INTEGRAL project study was conducted in 20 regions in 10 European countries (Table 1). Diversity among all the concerned areas derives not only from differences among

Table 1. INTEGRAL study regions (Betuch et al. 2015).

No.	Region	Country	Acreage (1000 ha)	Basic characteristics
1	Teteven	Bulgaria	70	Mountainous rural area with predominance of beech forests. Dispersed rural settlements and traditional land use. Issues: wood production, biodiversity, clean water, tourism and recreation.
2	Yundola		5	Wooded landscape with 90 % forest cover, managed by University of Forestry in Sofia. Rich physiographic and biological diversity, broad spectrum of vegetation and natural sightseeing, richness of mushrooms and herbs.
3	Pontenx	France	102	Important rural landscape with 66% forest cover primarily of maritime pine. One of the largest cultivated and privately owned (92%) region in Europe. Issues: wood production, water regulation, biodiversity, recreation, hunting.
4	Munich South	Germany	60	City-near forest landscape with 72% forest cover. Urban conurbation with a high economic, ecologic and recreational value. Important recreational area for urban population. Traditional forest use is in conflict with strong demand for recreational services as well as drinking water protection.
5	Upper Palatinate		300	Rural area with 53% forest cover. Predominance of small private forest owner (60%) and state of Bavaria (26%). Arising conflicts of the "new" forest biomass utilisation (mostly energy) with traditional forest products and conservation issues.
6	Newmarket	Ireland	75	Rural, agricultural area with 17% forest cover. State forests predominance. Conflicting objectives of timber production and biodiversity conservation. Issues: wood, fuelwood, biodiversity, clean water, soil erosion.
7	Western Peatlands		211	Areas of peatlands, afforested in 1950s–1960s, many considered to be 'in the wrong place' with wrong objectives and systems. Important in terms of water quality, biodiversity and landscapes.
8	Asiago	Italy	47	High share of public (municipal) property. Asiago Plateau is a well-known tourist destination. Issues: wood production, recreational activities, biodiversity.
9	Etna		25	North-western area of Mount Etna with 20% forest cover. High fragmentation of forest ownership. Active forest management is marginal and related mainly to public forests. Biodiversity conservation and recreation are of primary concern within the Natural Park area.
10	Molise		42	Mountain region with forest and rural environment. About 40% of state forests, the remaining forests are private with high fragmentation problems. Biodiversity is not considered in active forest management. Issues: wood production, non-wood forest products.
11	Suvalkija	Lithuania	66	Region with coniferous-deciduous forests. State forests predominance. Commercial use of forests dominates with only small portion of protected areas.
12	Žemaitija		38	Medium productive mixed spruce forests on relatively unproductive agricultural land, abandoned agricultural lands, could be afforested. Predominance of private forests. Management restrictions due to the presence of National park.
13	South-East Veluwe	Netherlands	8	Conservation of natural and cultural history is the main objective while timber production is important especially for the estates. The high recreational pressure and the effects of (over) grazing are the main management concerns currently.
14	Chamusca	Portugal	75	The rural region with forests and scrublands. The main species are cork oak, eucalyptus and pines. Issues: sustainable product supply, wildfires, certification, collaboration, climate change (drought).
15	Vale do Sousa		16	Region with high productive potential for *Eucalyptus globulus* and *Pinus pinaster*. Irregular topography, high number of small private owners with forest estates about 1.5 ha. Issues: sustainable timber supply and revenues, wildfires, collaborative forest management.
16	Leiria National Forest		11	The region with largest and oldest national forests representing the state forest management system. Targeted mostly for timber production and conservation or recreation. Issues: sustainable timber supply, wind protection and recreation.
17	Kysuce	Slovakia	98	Agricultural-woodland highland territory. High fragmented forest ownership structure with large proportion of non-state owners and unsettled ownership. Coniferous spruce forests affected by intensive and widespread necrosis accompanied by an incidental felling.
18	Podpoľanie		21	Agricultural-forest highland landscape with varying land-uses. Dispersed rural settlements and traditional land use. A large part of the region under the nature protection. Very productive forests and rich biodiversity. State forests predominance.
19	Helgeå	Sweden	152	Heavily forested region with private ownership predomination. Conflicting interests: timber production and biodiversity conservation, rural development and urbanization.
20	Vilhelmina		850	Rural area with a low population density. Boreal forest is to a great extend used for timber, bio-fuel and reindeer herding. Conflicting interests: timber production and biodiversity conservation, timber production and reindeer herding.

countries, but also within national conditions. Applying a uniform methodology in different regions of Europe allowed us to capture differences or similarities in the social, cultural, economic and environmental contexts of an integrated forest management in Europe.

2.2. Characteristics of Podpoľanie and Kysuce regions

The Podpoľanie and Kysuce regions are agricultural–woodland landscapes with more than 50% of forest cover and typical for their long tradition of agricultural and forestry use. Despite these similarities, the ownership structure and current state of the forests are remarkably different in these two areas. While in Podpoľanie state forest ownership dominates, a very fragmented ownership structure is typical for Kysuce, with the ownership of large acreages of forested land unsettled due to an unfinished restitution process. Besides this, the forest stands in Podpoľanie are relatively stable, productive, and healthy, while the health of spruce forests in Kysuce in the last decades has declined (e.g. Konôpka 2004; Kulla 2009; Hlásny et al. 2010), resulting in a high proportion of incidental felling.

Podpoľanie region

The Podpoľanie region is located in the central part of Slovakia, within Banská Bystrica Region and District Detva. The area is agricultural-forest land, with forests in the north and mainly agricultural areas in the south. Beech, fir-beech, and spruce forests are typical for the very productive upper part of the forest area, in contrast to the lower part where the Carpathian oak-hornbeam forests prevail. The northern part of the region is predominantly under nature protection, belonging to the Poľana Protected Landscape Area. The area is dominated by the massif of Poľana Mt., which is the highest extinct volcano in Central Europe; the entire mountain is part of the Carpathian arc. In a relatively small area mountain thermophile species of plants and animals also are present; thus, the region is known for its diversity and richness of flora and fauna. Moreover, the Podpoľanie region has a specific cultural landscape characterized by dispersed rural settlements and traditional land use by small private owners (Mojses & Petrovič 2013; Bezák & Mitchley 2014). Ownership of the forest land is split between the state (84.7%) and non-state entities (e.g. communal, private, and church owners), so State Enterprise Forests of the Slovak Republic is the strongest forestry subject in the region (Tuček et al. 2015).

Kysuce region

The Kysuce region is located in north-western Slovakia, bordering the Czech Republic in the west and Poland in the north. It belongs to the Žilina Region and completely covers two districts: Čadca and Kysucké Nové Mesto. The region is agricultural, with forests in the north and at higher altitudes (about 56%), and agricultural land mostly in the lower hollow basin and furrows separated by hills. Forest land ownership in the Kysuce region is characterized by very high fragmentation: state forest owners (19.5%), disputed ownership managed by state forest enterprise (33.9%), and non-state forest owners including private, communal, municipal, and church owners (46.3%) (Tuček et al. 2015). Almost half of the case study area is part of the Kysuce Protected Landscape Area covering the northeast and northwest parts of the territory. Tree species composition in the region has been significantly changed from the past. Spruce was previously considered a very economical fast-growing tree species; therefore, spruce monocultures have been commonly established in the region. In recent years, however, the region has been affected by intensive and widespread necrosis of spruce stands (Sitková et al. 2010; Bošeľa et al. 2014), which also interferes with protected and valuable ecosystems within the Kysuce Protected Landscape Area. The cause of mortality is the critical health condition of spruce stands, caused by complex of abiotic, anthropogenic, and biotic harmful factors with the dominant effect of honey fungus (*Armillaria*) and an aggressive species of bark beetles (Hlásny & Sitková 2010). These factors are the cause of frequent calamities, so the Kysuce region belongs to the regions with the highest volume of incidental felling in Slovakia (e.g. in 2010 incidental felling represented 97% of total felling in Čadca District and 100% in Kysucké Nové Mesto District) (Vakula 2011).

2.3. Data collection

2.3.1 Primary and secondary data collection

Within the INTEGRAL project the various drivers and barriers were analysed at (i) local level of study regions, (ii) national and (iii) European level. Identification of various determinants of forest management in different regions was based on primary data (structured in-person interviews) and secondary data (output of qualitative analysis of national and European documents).

In Slovakia primary data were obtained via 50 in-person interviews with forest owners, managers from the Podpoľanie and Kysuce regions, and other relevant actors at the sub-national and national levels (Brodrechtová et al. 2016). The output of this research phase was the identification of subset of 22 drivers and barriers of forest management decision-making on regional level. More precisely, biophysical conditions and attributes of the community, including the politico-economic context, institutions, and discourses, were among the significant drivers affecting forest owners and managers, and their interactions and decisions concerning forest management in the Podpoľanie and Kysuce regions.

Analysis of secondary data in the form of desktop research was conducted parallel to the primary data collection. First, an extensive review of existing national documents (e.g. strategic and prognostic documents related to forestry, nature protection, and the rural economy) was conducted. This resulted in the isolation of subset of 28 drivers and barriers, including bio-physical conditions and attributes of the community, politico-economic contexts, and institutions that can potentially determine decisions concerning forest management in Slovakia. Second, European Union (EU) documents (e.g. regulations and directives concerning fore-

stry, nature protection, and energy) were subsequently systematically scrutinized, which resulted in the identification of subset of 35 potential drivers and barriers of forest management (Riemer, 2013). These factors concerning attributes of the community, including demographic and technology development, politico-economic context, institutions, and discourses provided a wide overview of possible barriers and drivers of forest management in Europe.

2.3.2 Selection of relevant factors

The total set of 85 local, national, and EU drivers and barriers of forest management decision making as an outcome of broad diagnostic analysis represented a base for further investigation. More detailed analysis of the forest management factors with the help of structural analysis resulted in a required reduction to 15 – 25 relevant factors for each region (Schüll 2013).

Reduction to 15 – 25 relevant factors was completed at a workshop attended by 10 experts from Technical University and National Forest Centre, both in Zvolen, Slovakia. From the list of 85 factors, every expert chose 20 factors considered relevant for the further development of forest management decision making in the Podpoľanie and Kysuce regions. Subsequently, the experts ranked every chosen factor from most important to least important. Finally, the factors were evaluated by the frequency analysis, taking into account the frequency and ranking of the factors. The findings of the analysis were set at 20 relevant factors for each region. The factors were afterwards thematically grouped according to the STEEP categories (Table 2). STEEP is an acronym for societal fields 'society', 'technology', 'economy', 'ecology' and 'politics'. The allocation of factors to these categories helped to identify a possibly unbalanced selection.

2.4. Data analysis

2.4.1 Participatory workshops

To determine key drivers and barriers to future forest management, a structural analysis was applied. The basic idea behind the analysis was to isolate and assess the relative mutual influences of the key factors affecting forest management. Each factor was assessed according to its influence on the other factors included in the analysis and also according to how strongly it was affected by the other factors (Glenn & Gordon 2009). In order to grasp the view of regional stakeholders in Podpoľanie and Kysuce, and to decrease subjectivity in factors assessment, the structural analysis was carried out via participatory workshops. In each region, seven regional stakeholders participated (from 15 invited in Podpoľanie and from 11 invited in Kysuce) at a half-day workshop (Table 3).

2.4.2 Conducting structural analysis

The task of the workshop participants was to assess the relationship among 20 relevant factors that will significantly influence forest management in their regions. First, these factors were structured into STEEP categories and explained to participants. Each factor was introduced individually, with discussion about why it was considered a factor that will influence future forest management. Second, each participant received the *structural analysis matrix* worksheet printed in A3 format (Fig. 1). This matrix consisted of 20 relevant factors listed in columns and rows. Finally, the participants answered two questions for each pair of factors: (1) *How strongly does one factor affect the other one?* and (2) *To what extent can the development of one factor be explained*

Table 2. 20 relevant drivers and barriers of forest management for Podpoľanie and Kysuce regions.

Level of evaluation STEEP category	Macro level	Meso level	Micro level
Society		SOC1 Demography development SOC3 Public opinion	SOC2 Qualified workforce SOC4 Codes of conduct
Technology		TEC1 Innovation and technology TEC2 Wood processing industry	
Economy	ECN2 Timber market ECN3 Bioenergy market	ECN4 Tourism	ECN1 Forest owners economic situation ECN5 Forest management Costs
Ecology	ECO3 Climate change		ECO1 State and structure of forest ECO2 Abiotic and biotic harmful factors ECO4 Non-wood ecosystem Services
Politics	POL1 Environmental policy and legislation POL2 Forest policy and legislation POL3 Rural Development policy	POL5 Subsidies and compensations	POL4 Forest ownership Structure

Table 3. Basic characteristics of workshop participants in Podpoľanie and Kysuce regions.

	Podpoľanie region								Kysuce region							
		Position		Education		Age				Position		Education		Age		
	Actors	D	M	H	S	40±	50±	60±	Actors	D	M	H	S	40±	50±	60±
State forest managers	1	1		1			1		1		1	1		1		
Private forest owners	1	1		1		1			2		2	1	1	2		
District government	1		1	1		1			2	1	1	2		1		1
State nature protection	1	1		1		1			—							
National Forest Centre	1		1	1		1			1		1	1		1		
Slovak association of wood processors	1		1	1		1			—							
Non-state forest owner association	1		1	1				1	1		1	1			1	
Total	7								7							

Abreviations: D – Director/Chairman; M – Manager; H – Higher; S – Secondary.

by the development of the other factor? (Schüll, 2013). In order to avoid a negative group effect, everyone filled out the printed *structural analysis matrix* worksheet individually. The participants were given sufficient time to carefully consider their responses.

An evaluation of individual factors' influence in the structural matrix was measured on a Likert scale where 0 = no influence, 1 = weak influence, 2 = medium influence, and 3 = strong influence. Subsequently, an arithmetical average of values for each matrix cell was calculated. While the resulting *structural analysis matrix* reflected the view of all participants, the opinion of each participant was weighted equally and not influenced by collective thought. Furthermore, the sums of rows and columns in the *structural analysis matrix* represented metrics for the level of mutual relationships among the considered factors. While the "row sum" represented the Active value (AV) of a factor and indicated how strongly that factor affects other factors, the "column sum" of a factor represented the Passive value (PV) of a factor and indicated how strongly that factor is influenced by other factors. In this way, every factor was evaluated according to the relationship between its Active and its Passive values (Fig. 1).

2.4.3 Conducting structural analysis with the help of Parmenides EIDOS™

The structural analysis applied via participatory workshops was carried out with the help of the program Parmenides EIDOS™ software, which is usually used in decision-making processes and strategic decisions. Its analytical and visualization functions help experts to identify key elements, especially in complicated and complex processes that require a multidisciplinary approach (Navrátil et al. 2014). Moreover, the Active and Passive values of the factors could be displayed by means of the Active/Passive Map. More precisely, the Parmenides EIDOS™*'s* program module *Situation Analysis* allows all assessed factors to be displayed in coordinate axes using the individual Active and Passive values as their x- and y-coordinates (Fig. 2). In the map four groups of factors are distinguished (Schüll 2013): (i) **active** or influent factors (with high AV and low PV) located in the upper left quadrant, (ii) **dynamic** or critical factors (with high AV and high PV) located in the upper right quadrant, (iii) **excluded** or lazy factors (with low both AV and PV) located in the lower left quadrant, and (iv) **passive** or depending factors (with low AV and high PV) located in the lower right quadrant.

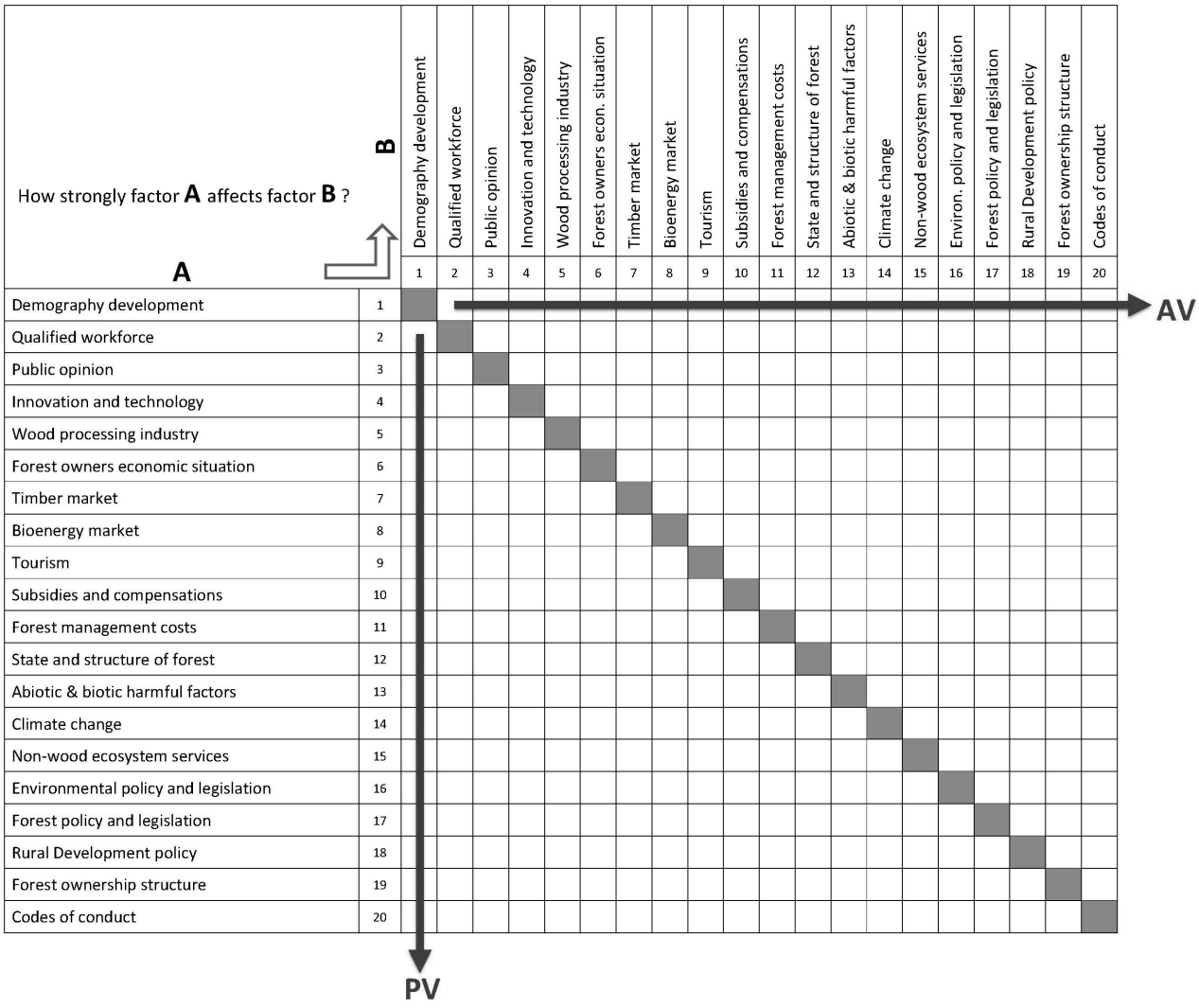

Fig. 1. *Structural analysis matrix* with 20 relevant factors used in participatory workshops.

For instance, **active** factors influence future forest development more than they are influenced by other factors (i.e., they are very influential and have a low dependency). These factors are hard to steer and control given their low PV. Dynamic factors are very influential and at the same time very dependent; thus, any action on them has consequences on the other assessed factors. Since excluded factors have little influence and, at the same time, little dependence, they are rather isolated from the rest of the assessed factors. Passive factors are influenced more strongly than they influence other factors. They are also sensitive to the development of other especially dynamic factors. In summary, the higher the position of a factor on the map, the stronger it affects the other factors. In contrast, the right-most position means that the factor is heavily affected by the other factors. Consequently, factors with high AV are factors of special importance. While the active factors can probably serve as major key drivers or barriers for the future development of forest management, dynamic factors should receive special attention, because they are more likely to change and more likely to be changed (Schüll 2013).

2.4.4 Selection of key factors

The results of the structural analysis realized within the participatory workshops were twofold: (i) key factors were isolated according to Active and Passive values, and (ii) key factors were isolated according to Active/Passive maps. The Active and Passive values were used to compare key factors from Slovak regions with factors in other INTEGRAL regions. However, the final selection of key factors in the Podpoľanie and Kysuce regions was based on Active/Passive maps and subsequent discussion with stakeholders in participatory workshops. Distribution of factors in individual quadrants of maps was presented to stakeholders at the end of the workshops. The following discussions resulted in final identification of key drivers and barriers for forest management in the Podpoľanie and Kysuce regions.

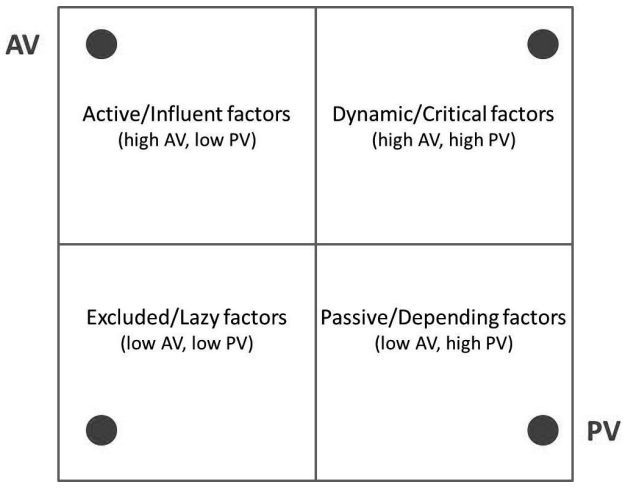

Fig 2. Distribution of factors in Active/Passive map.

2.4.5 Comparison of results within project INTEGRAL

Resulting Active and Passive values of factors from the Podpoľanie and Kysuce regions were compared with Active and Passive values of factors identified in other INTEGRAL regions. In order to ensure the comparability of results, Active and Passive values from the Podpoľanie and Kysuce regions were modified. First, as not all regions used the same Likert scale for their structural analysis (some used 0 – 3; some used 0 – 10), the results were adjusted to a consistent scale ranging from 0 to 10. Second, since the structural analysis across the INTEGRAL regions also differed by the number of involved factors, adjusted active and passive values of each factor were calculated using the following formulas:

$$AVad = \left[\frac{\sum_1^n AV}{(n-1)}\right] \times 10$$

$$PVad = \left[\frac{\sum_1^n PV}{(n-1)}\right] \times 10$$

(Av_{ad} – adjusted Active value and PV_{ad} – adjusted Passive value). The range of the scale used and the number of factors involved across INTEGRAL regions ensured comparability of the results (Hinterseer et al. 2014).

2.4.6 Analysis of factors according to STEEP categories

The factors were also assessed by their frequencies within the STEEP categories. This gave a picture of the importance of individual societal domains for the development of forest management. However, the frequencies do not give any information about the overall influence of each STEEP category. Therefore, in both the Podpoľanie and Kysuce regions, the Global Active values for each STEEP category were calculated by adding the Active values of the individual factors. Subsequently, the results of Slovak regions were compared with the factors isolated in other INTEGRAL regions. Again, the adjusted Active values were used to ensure comparability.

3. Results and discussion

3.1. Active and Passive values – Podpoľanie and Kysuce regions

In the Podpoľanie region (Table 4), the highest Active values were assigned to two policy factors (*Subsidies and compensations, Forest policy and legislation),* followed by the economic factor (*Forest owners' economic situation*). The factors with the highest Passive values, and therefore the factors most affected by other assessed factors, were *Forest owners' economic situation*, *State and structure of forest,* and *Forest management costs*.

In the Kysuce region (Table 5), the regional stakeholders assigned the highest Active values to ecological factors (*Climate change*, *Abiotic and biotic harmful factors*, *State and*

structure of forest) and economic factors *(Subsidies and compensations)*. The factor that had the highest Passive value was *Forest owners' economic situation* followed by the *Forest management costs* and *Timber market*.

While the most influential factors with high Active values in the Podpoľanie region were mainly political, in the Kysuce region, the most influential factors with high Active values were mainly ecological. This could be attributed to the regional stakeholders' perception of unfavourable health conditions of the Kysuce forests. Additionally, in both regions the factors *Subsidies and compensations* and *Forest policy and legislation* were among the top-ranked influential factors.

Table 4. Active and passive values of factors in Podpoľanie region.

Podpoľanie region							
Rank	Code	Factor	Total AV	Rank	Code	Factor	Total PV
1	POL5	Subsidies and compensations	6.32	1	ECN1	Forest owners' economic situation	6.95
2	POL2	Forest policy and legislation	6.23	2	ECO1	State and structure of forest	6.60
3	ECN1	Forest owners' econ. situation	5.95	3	ECN5	Forest management costs	6.49
4	POL4	Forest ownership structure	5.88	4	ECN3	Bioenergy market	6.09
5	POL3	Rural Development policy	5.75	5	ECN2	Timber market	5.88
6	ECN2	Timber market	5.63	6	POL5	Subsidies and compensations	5.77
7	ECO1	State and structure of forest	5.51	7	TEC2	Wood processing industry	5.72
8	SOC4	Codes of conduct	5.49	8	ECO4	Non-wood ecosystem services	5.58
9	ECN5	Forest management costs	5.47	9	POL3	Rural Development policy	5.49
10	ECN3	Bioenergy market	5.23	10	TEC1	Innovation and technology	5.32
11	ECO3	Climate change	5.19	11	POL2	Forest policy and legislation	5.19
12	ECO2	Abiotic and biotic harmful factors	5.11	12	ECN4	Tourism	5.04
13	ECO4	Non-wood ecosystem services	4.74	13	SOC3	Public opinion	4.74
14	TEC1	Innovation and technology	4.58	14	POL1	Environ. policy and legislation	4.74
15	POL1	Environ. policy and legislation	4.54	15	ECO2	Abiotic and biotic harmful factors	4.51
16	TEC2	Wood processing industry	4.28	16	SOC4	Codes of conduct	4.37
17	SOC1	Demography development	3.81	17	SOC2	Qualified workforce	3.46
18	ECN4	Tourism	3.68	18	POL4	Forest ownership structure	3.35
19	SOC2	Qualified workforce	3.67	19	ECO3	Climate change	2.60
20	SOC3	Public opinion	2.89	20	SOC1	Demography development	2.14

Table 5. Active and passive values of factors in Kysuce region.

Kysuce case region							
Rank	Code	Factor	Total AV	Rank	Code	Factor	Total PV
1	ECO3	Climate change	6.32	1	ECN1	Forest owners' economic situation	7.37
2	ECO2	Abiotic and biotic harmful factors	6.18	2	ECN5	Forest management costs	6.91
3	POL5	Subsidies and compensations	6.11	3	ECN2	Timber market	6.63
4	ECO1	State and structure of forest	6.11	4	ECO1	State and structure of forest	6.14
5	POL2	Forest policy and legislation	5.86	5	ECN3	Bioenergy market	5.96
6	ECN5	Forest management costs	5.75	6	TEC1	Innovation and technology	5.89
7	SOC2	Qualified workforce	5.75	7	POL3	Rural Development policy	5.79
8	ECN1	Forest owners' econ. situation	5.65	8	POL5	Subsidies and compensations	5.72
9	ECN2	Timber market	5.54	9	TEC2	Wood processing industry	5.72
10	POL1	Environ. policy and legislation	5.54	10	POL2	Forest policy and legislation	5.51
11	POL4	Forest ownership structure	5.47	11	SOC2	Qualified workforce	5.47
12	TEC1	Innovation and technology	5.44	12	ECN4	Tourism	5.40
13	TEC2	Wood processing industry	5.26	13	SOC3	Public opinion	5.33
14	POL3	Rural Development policy	5.19	14	POL1	Environ. policy and legislation	5.09
15	SOC1	Demography development	5.02	15	ECO2	Abiotic and biotic harmful factors	5.05
16	SOC3	Public opinion	4.67	16	ECO4	Non-wood ecosystem services	4.91
17	ECN3	Bioenergy market	4.53	17	POL4	Forest ownership structure	4.81
18	ECN4	Tourism	4.42	18	SOC4	Codes of conduct	4.21
19	ECO4	Non-wood ecosystem services	4.35	19	ECO3	Climate change	2.91
20	SOC4	Codes of conduct	4.21	20	SOC1	Demography development	2.53

Table 6. Active and passive values of factors from other INTEGRAL regions (Hinterseer et al. 2014).

INTEGRAL regions					
Rank	Factor	Total AV	Rank	Factor	Total PV
1	Policies, laws and regulations	104.42	1	Policies, laws and regulations	91.17
2	Ownership structure	88.24	2	Timber market	73.23
3	Timber market	79.16	3	Ownership structure	68.70
4	Population	60.48	4	Bioenergy market	53.91
5	Bioenergy market	55.03	5	Subsidies	49.96
6	Climate change	54.27	6	Owner`s norms, values & objectives	49.72
7	Subsidies	48.51	7	Management plans	48.77
8	Non-wood ecosystem services	48.50	8	Non-wood ecosystem services	44.12
9	Management plans	46.88	9	Owner`s economic situation	44.12
10	Owner`s norms, values & objectives	40.96	10	Population	42.07
11	Owner`s economic situation	38.38	11	Public opinion	40.16
12	Forest calamities	36.31	12	Timber processing industry	39.21
13	Public opinion	36.14	13	Forest structure	38.72
14	Timber processing industry	35.34	14	Climate change	36.33
15	Forest structure	34.26	15	Rural Development (Plans/Activities)	36.31
16	Rural Development (Plans/Activities)	34.11	16	Technology	34.24
17	Technology	31.34	17	Forest road network	32.59
18	Forest services and functions	29.06	18	Type of silviculture	31.11
19	Forestry paradigms	27.43	19	Forest services and functions	29.91
20	Certification	25.79	20	Management costs	26.70

Comparison of the Passive values in Podpoľanie and Kysuce revealed that the top five influenced factors (*Forest owners' economic situation*, *Forest management costs, State and structure of forest*, *Timber market,* and *Bioenergy market*) were similar. According to their Active and Passive values, six factors (*Forest owners' economic situation, Subsidies and compensations, State and structure of forest, Forest management costs, Timber market,* and *Forest policy and legislation)* were therefore identified as key factors for future forest management of both the Podpoľanie and Kysuce regions.

3.2. Active and passive values – other INTEGRAL regions

Comparison across INTEGRAL regions (Table 6) revealed that *Policies; laws and regulations*; *Timber market*; *Ownership structure*; *Bioenergy market*; *Subsidies;* and *Owner`s norms, values, and objectives* were important for future forest management. Moreover, the first three factors have both the highest active and passive values, considerably higher than other factors. Accordingly, based on the perception of regional stakeholders across Europe, the *Policies, laws and regulations*, *Timber market,* and *Ownership structure* factors were crucial for future forest management in Europe.

If compared to the Slovak regions, the *Policies, laws and regulations*, *Timber market,* and *Subsidies* factors were universal for both Slovak and other European regions. However, for stakeholders from the Podpoľanie and Kysuce regions, *State and structure of forest*, *Forest management costs,* and *Forest owners' economic situation* were also important factors.

3.3. Evaluation of factors according to STEEP categories

In terms of frequency of factors within STEEP categories in the Podpoľanie and Kysuce regions, the *Policy* category had the highest number of factors (Table 7). Comparison across INTEGRAL regions showed similar results. There was a considerable gap between *Policy* and other categories such as *Economy*, *Society* and *Ecology*. Across all INTEGRAL regions, the *Technology* category was far behind all other categories.

Table 7. Frequency of factors grouped by STEEP categories.

STEEP category	Frequency	
	Podpoľanie and Kysuce regions	INTEGRAL regions
Society	4	85
Technology	2	46
Economy	4	88
Ecology	4	71
Policy	5	102

In both Slovak regions, the ranking of STEEP categories according to Global Active values showed similar findings in the number of factors in each category (Table 8). Specifically, in Podpoľanie and Kysuce, the *Policy* category had not only the highest frequency of identified key factors, but it also had the highest overall impact. The Global Active values of the *Economy*, *Ecology,* and *Society* categories indicated differences in their relevance despite the same number of factors. In both regions, the *Technology* category had the least impact, with a huge gap between it and other categories in ranking. In sum, according to the Global Active values the STEEP categories *Policy*, *Economy,* and *Ecology* were considered societal domains with the highest importance for future forest management in the regions of Podpoľanie and Kysuce.

From the European perspective, the comparison of STEEP categories by Global Active values revealed both similarities and differences with the Slovak regions. The *Policy* category was ranked the highest, whereas *Technology* had the lowest ranking (Table 8). In contrast, in the Slovak regions the *Economy* category was the second most important; in INTEGRAL regions the second most important category was *Society*. Thus, there were apparent dissimilarities between stakeholders' perceptions of societal factors in Slovak and in other European regions involved in INTEGRAL.

Table 8. STEEP categories and their Global Active values.

Podpoľanie region			Kysuce region			*INTEGRAL regions		
Rank	STEEP Category	Global AV	Rank	STEEP Category	Global AV	Rank	STEEP category	Global AV
1.	Policy	28.72	1.	Policy	28.18	1.	Policy	426.86
2.	Economy	25.96	2.	Economy	25.89	2.	Society	344.72
3.	Ecology	20.54	3.	Ecology	22.95	3.	Economy	319.28
4.	Society	15.86	4.	Society	19.65	4.	Ecology	241.95
5.	Technology	8.86	5.	Technology	10.7	5.	Technology	163.29

* Hinterseer et al. 2014.

3.4. Active/Passive maps – Podpoľanie and Kysuce

Active/Passive Maps were used for easier and transparent visualization of the results during participatory workshops and subsequent discussion of findings with regional stakeholders. The resulting distribution of factors in maps showed at a glance how strongly each factor acted on all other factors and how strongly it was affected by other factors (Fig. 3).

In Podpoľanie the distribution of factors and their concentration in the right upper quadrant demonstrates their dynamics as well as their strong connection among each other. Policy factors *Subsidies and compensations* (POL5), *Forest policy and legislation* (POL2), and *Rural development policy* (POL3) clearly formed the group of most **dynamic** factors. Similarly, the majority of economic and ecological factors were dynamic factors. Factors located in the upper left corner, *Ownership structure* (POL1), *Climate change* (ECO3), and *Demography development* (SOC15), were determined to be **active;** thus, they were very influential and uncontrollable factors. *Public opinion* (SOC3) fell into the lower right quadrant as the only **passive** factor. No one factor was determined to be an **excluded** factor.

The factors in Kysuce were more dispersed. The current unfavourable state of forests in the region was reflected in the highest positions of the ecological factors *Climate change* (ECO3), *State and structure of forest* (ECO1), and *Abiotic and biotic harmful factors* (ECO2). The latter two factors formed the group of **dynamic** factors along with *Subsidies and compensations* (POL5), *Forest policy and legislation* (POL2), *Forest management costs* (ECN5), *Qualified workforce* (SOC2), *Forest owners' economic situation* (ECN1), and *Timber market* (ECN2). *Climate change* (ECO3) and *Forest ownership structure* (SOC4) were deter-

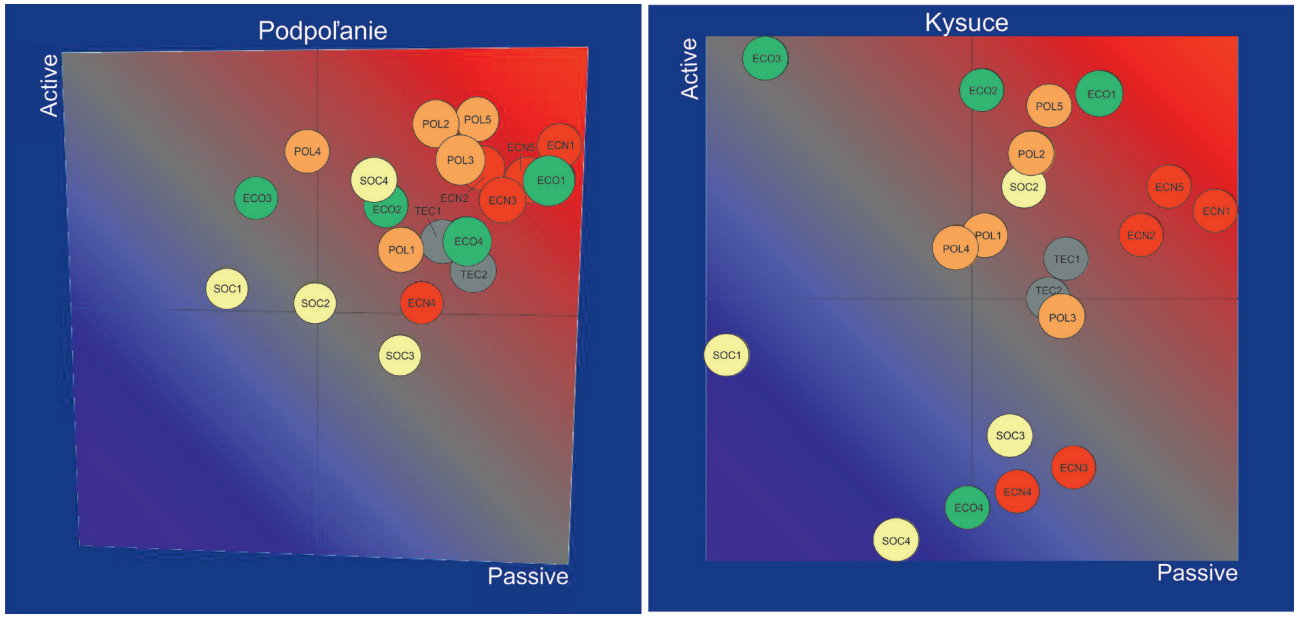

Fig 3. Active/Passive Maps for Podpoľanie and Kysuce regions (Society – yellow, Technology – grey, Economy – red, Ecology – green, Policy – orange).

mined to be **active** factors. The lower left quadrant contained the **passive** factors *Public opinion* (SOC3), *Bioenergy market* (ECN3), *Tourism* (ECN4), and *Non-wood ecosystem services* (ECO4). Two societal factors, *Demography development* (SOC1) and *Codes of conduct* (SOC4), formed the group of excluded factors.

3.5. Selection of key factors according to Active/Passive maps and discussion in participatory workshops

The visualization of results via the Active/Passive maps (Fig. 3) supported discussion with workshops participants, who helped to detect the subtle differences between the Podpoľanie and Kysuce regions, which in turn aided the final selection of key factors for future forest management in both regions.

Comparison of the Active/Passive maps of Podpoľanie and Kysuce revealed apparent dissimilarities as well as commonalities between the regions. The most dynamic factors in Podpoľanie were political and in Kysuce were ecological. In other words, in Kysuce the position of factors *State and structure of forest* (ECO1), and *Abiotic and biotic harmful factors* (ECO2), mirrored the current poor health of forest stands and excessive incidental felling, which was confirmed by Kysuce's stakeholders in the workshop discussion.

Looking at the distribution of policy factors (Fig. 3), it is evident that in both regions all factors are in the right upper quadrant or on its border. While the *Rural development policy* (POL3) was classified by stakeholders in Podpoľanie as a clearly dynamic factor, in Kysuce it was located on the border of passive factors. In both maps, the leftmost policy factor *Forest ownership structure* (POL4) influenced the remaining factors much more strongly than it was influenced. Despite the diametrically different situation in the ownership structure between these two regions (state ownership predominance in Podpoľanie; highly fragmented ownership structure in Kysuce), stakeholders in both regions expressed the opinion that forest ownership significantly affects forest management, but it is hard to control its arrangement. Thus, *Forest ownership structure* was regarded by stakeholders as a stable factor, although stakeholders from Kysuce especially stressed the need for an adjustment of fragmented ownership structure.

With the exception of *Tourism* (ECN4) and *Bioenergy market* (ECN3, in Kysuce), in both maps all other economic factors were very influential and at the same time very dependent. The dynamic factors *Forest owners' economic situation* (ECN1), *Timber market* (ECN2), and *Forest management costs* (ECN5) were in close proximity, situated furthest to the right of all factors. This illustrates the stakeholders' perception that those factors significantly affect forest management in their regions but, at the same time, could be seriously influenced by other factors. Thus, stakeholders from both regions stated during discussions that these factors might be classified as crucial factors. While the *Bioenergy market* (ECN3) factor was classified as dynamic factors in Podpoľanie, surprisingly, it was classified as a passive factor in Kysuce. Stakeholders from Kysuce have mentioned that they still consider the *Timber market* factor more important than the *Bioenergy market* factor.

In both regions, the factor *Non-wood ecosystem services* (ECO4) had the least importance of all ecological factors that were considered; even in Kysuce the factor was located on the boundary between excluded and passive factors. In both maps, the most affected (rightmost) ecological factor was *State and structure of forest* (ECO1). Contrariwise, the leftmost ecological factor *Climate change* (ECO3) illustrates the stakeholders' perception that one of the major ecological drivers can be influenced very little.

The distribution of societal factors in both maps showed that in each region just one factor was determined to be dynamic. While in Podpoľanie the *Codes of conduct* (SOC4) was

rated as very influential and at the same time a very dependent social factor, conversely, in Kysuce this factor was determined to be the least influential factor of all 20 assessed factors. It seems that in Podpoľanie stakeholders perceived the significance of informal institutions, while stakeholders in Kysuce were more worried about different problematic issues. In subsequent discussions, stakeholders in Podpoľanie confirmed the impact of informal institutions (e.g., clientelism, lobbying, and networking) and expressed their concerns about the influence of political or financial groups. Although stakeholders in Kysuce also perceived these types of influences, they did not consider it as serious a problem. Kysuce's stakeholders considered fragmented ownership structure the main problem. As the size of state owned forests in Kysuce (19.5%) is smaller than that of Podpoľanie (84.7%), the influence of the political and financial groups is less pronounced. On the other hand, the lack of skilled labour in Kysuce was reflected in the position of *Qualified workforce* (SOC2), which was classified as a dynamic factor. Stakeholders in Kysuce confirmed in discussion the concerns about shortages of skilled workers in the near future. *Public opinion* (SOC3) was placed in both maps more among passive factors than active ones. Even in Podpoľanie, this factor received the lowest active sum of all the assessed factors; thus, according to stakeholders, it was influenced more strongly by other factors than it acted on them. In both cases, the leftmost factor was clearly *Demography development* (SOC1). Despite its higher active value compared to other social factors, *Public opinion*, *Qualified workforce* (in Podpoľanie), and *Codes of conduct* (in Kysuce), stakeholders perceived this social factor in both case study areas as a societal driver that was influenced very little by other factors.

In both maps, the technological factors *Innovation and technology* (TEC1) and *Wood processing industry* (TEC2) were in close proximity to each other. Although they were in the upper right quadrant, their position near the boundary of passive factors indicates that they had less influence because they were affected by other factors. Subsequent discussions confirmed stakeholders' perception that innovations and the renewal of vehicle fleet are influenced mainly by availability of finances.

Table 9. Key strategic drivers and barriers of forest management in Podpoľanie and Kysuce regions.

Podpoľanie region		Kysuce region	
Rank	Isolated key factor	Rank	Isolated key factor
1.	POL5 – Subsidies and compensations	1.	ECO1 – State and structure of forest
2.	POL2 – Forest policy and legislation	2.	ECO2 – Abiotic and biotic harmful factors
3.	ECN1 – Forest owners' economic situation	3.	POL5 – Subsidies and compensations
4.	POL3 – Rural development policy	4.	POL2 – Forest policy and legislation
5.	ECN2 – Timber market	5.	ECN5 – Forest management costs
6.	ECO1 – State and structure of forest	6.	ECN1 – Forest owners' economic situation
7.	ECN5 – Forest management costs	7.	SOC2 – Qualified workforce
8.	ECN3 – Bioenergy market	8.	ECN2 – Timber market
9.	SOC4 – Codes of conduct		

In summary, according to the Active/Passive map and discussion with stakeholders, in the Podpoľanie region the set of nine key drivers and barriers to forest management was finally isolated (Table 9). The highest ranked were policy factors (*Subsidies and compensations*, *Forest policy and legislation*, and *Rural development policy*) and the economic factor *Forest owners' economic situation*. Ecological and societal factors were represented by *State and structure of forest* and *Codes of conduct*. In the Kysuce region eight key factors were selected that will affect forest management in the future (Table 9). The most important were two ecological factors (*State and structure of forest*, *Abiotic and biotic harmful factors*), followed by policy, economic factors, and the societal factor *Qualified workforce*.

4. Conclusions

Findings of structural analysis showed similarities as well as differences between the Podpoľanie and Kysuce regions. Although in both regions, political factors were among the dominant factors, stakeholders in the Kysuce region also very strongly perceived the adverse impact of harmful factors on the current state of their forests, and thus on the entire forest management in Kysuce. Results in Podpoľanie indicated that if the forests are relatively healthy and in good condition, the main societal domains driving forest management are Policy and Economy. The Active/Passive maps which resulted and subsequent discussions during workshops also revealed a slightly different perception of societal factors in both regions. In Podpoľanie, the prevalence of state owned forests is an obvious influence of the informal institution of forest management. In contrast, in Kysuce, with its highly fragmented ownership structure and prevalence of non-state owners, this impact is not so significant.

Commonalities and dissimilarities were also revealed between Slovak and other European regions involved in the INTEGRAL project. The STEEP category Policy seems to be the main societal domain affecting forestry and forest management across Europe. In Slovak and INTEGRAL regions, the Policy category dominated by influencing a number of factors and also through its overall impact. In general, forest, environmental or rural development policies, and laws and regulations were perceived by stakeholders from other European regions as the factors with the highest importance for forest management. Additionally, the technological factors were considered to follow forest development rather than drive it. Differences in results concerned perception of social factors. While the STEEP category Society was ranked high in INTEGRAL regions, stakeholders in Slovak regions preferred economic and ecological factors.

This study's contribution was on a theoretical level as well as on a methodological level. The future research method of structural analysis proved to be a suitable instrument for comparing a mixture of qualitative and quantitative factors influencing forest management. Since the analysis compares the relevant factors based on their mutual influence, it is essential to properly select the relevant factors to be analysed. It is important to include all relevant factors that affect the analysed system, which in this case is forest management. As the structural analysis allows comparison at first glance of seemingly incomparable qualitative (e.g., climate change) and quantitative (e.g., timber market) factors, it appears to be a suitable method of application in forestry.

Using Active/Passive values was particularly appropriate for evaluation of the overall impact of individual STEEP categories. Active/Passive maps allowed more detailed comparison of the various factors that were considered. The Parmenides Eidos™ analytical tool allowed visualization of the individual stakeholder's perception of a factor's importance. Distribution of factors in the map's quadrants is much more readable and transparent as simply Active or Passive values.

The application of the structural analysis in participatory manner proved to be very suitable for identification of drivers and barriers to forest management. For correct implementation of the method it was necessary that the workshop participants represented different interest groups of regional stakeholders. Our results confirmed other researches that stakeholder's participation in forestry decision-making might provide regional expertise, increase the legitimacy of final outcome (e.g. Beckley et al. 2005) and strength the involvement of local stakeholders in policy-making processes (e.g. Sarvašová 2014; Marzano et al. 2015; Sarvašová 2016).

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