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Article in *Science of The Total Environment* · February 2018

DOI: 10.1016/j.scitotenv.2017.07.065

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Social-ecological innovation in remote mountain areas: Adaptive responses of forest-dependent communities to the challenges of a changing world



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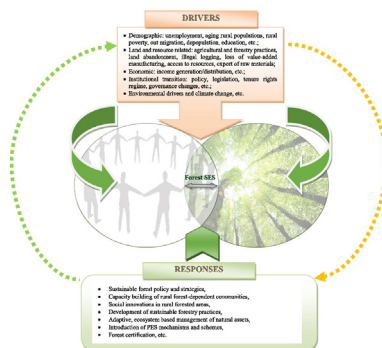
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HIGHLIGHTS

- Mountain forests can assist in reducing societal vulnerability of forest dependent communities.
- A combined DPSIR-ES approach proved to be useful for identifying human responses.
- The heterogeneity of perceptions reflecting on forest related decision-making has been untangled.
- Expert evaluation of the FSES can assist in designing policy and practice measures to enhance sustainability.

GRAPHICAL ABSTRACT



ARTICLE INFO

Article history:

Received 30 March 2017

Received in revised form 3 July 2017

Accepted 8 July 2017

Available online xxxx

Keywords:

Forest ecosystem services

Well-being

Multifunctional forestry

Marginalised rural areas

Ukrainian Carpathians

ABSTRACT

To better understand how constantly changing human–environment interactions could be better organized to respond to current challenges, we examined the Ukrainian Carpathians as an example case of complex forest social-ecological systems (FSES). We did it by interviewing diverse and relevant local stakeholder (N = 450). In particular, we strived to: i) outline how people and nature are linked and interact in coupled FSES; ii) examine the preferences of stakeholders on the forests and associated ecosystem services (ES); iii) map key drivers threatening well-being of FSES and iv) identify potential responses to address the challenges at a local scale. To answer these questions we followed a mixed method route by integrating qualitative (participatory) and quantitative data collection and analyses, with further application of a Driving Force–Pressure–State–Impact–Response (DPSIR) framework in combination with the ES approach in order to assess benefits, threats to these benefits, and responses regarding the studied FSES. We found that the key benefit from FSES is timber and non-wood forest products (like berries and mushrooms), but also various regulating services were ranked highly by respondents. To explore social-ecological innovation, with potential responses of forest-dependent communities to challenges they face, we employed a commonly used assumption that governance must fit to the particular characteristics of FSES in order to enable sustainability. For the particular case of the Ukrainian Carpathians, we identified and discussed the following five nonconformities or “misfits” threatening sustainability: 1) Spatial misfit in

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legislation; 2) Poor contextualization; 3) Trap of the single ES; 4) Participatory misfit; and 5) Robbing the commons. By conceptualizing those key threats, we proposed responses for sustainability. The findings contributed to an advanced understanding of complex FSES, their key challenges and potential solutions in order to secure well-being of people and nature in coupled social-ecological systems, in the conditions of a changing world.

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1. Introduction

Recent debates involving scientists, policymakers and development agencies have been focused on social-ecological systems (SES) with special attention being paid to human well-being (United Nations, 2015) and environmental sustainability (Millennium Ecosystem Assessment, 2005) and key driving forces, as well as critical uncertainties associated with them (Sarkki et al., 2016). SES are composed of ecological systems, providing basis for ecosystem services (ES), social systems diverging across stakeholder groups, and policy, and governance systems, and instruments at various levels (Ostrom, 2009). Berkes et al. (2016) consider SES as integrated complex systems that include social (human) and ecological (biophysical) subsystems in a two-way feedback relationship. The system outputs are returned to the system as an input, either to oppose the initial input (negative feedback) or to enhance it (positive feedback).

Human well-being depends on ecosystem services (ES) (Costanza et al., 2014; Knight and Rosa, 2011). Social systems are affected by changes in the functioning ecosystems and by the resultant flow of their services (Nijnik and Miller, 2013); while the ES are affected by human behaviours, including, at times, by unsustainable use of natural resources to meet human's objectives. Due to the complexity of SES and the observed causality between the ES provision and human well-being, it is necessary to improve knowledge of the inter-linkages. This, in turn, will assist in developing socially-ecologically innovative responses to address the challenges that natural resource-dependent communities are currently facing.

This paper examines the interrelations of these systems in an in-depth manner, combining the use of ES, SES and Driving Force-Pressure-State-Impact-Response (DPSIR) concepts under a single analytical framework. Natural resources have a considerable influence on human well-being at all scales by generating multiple benefits (Nassl and Löffler, 2015). The well-being of people is threatened by increasing damages to or/and losses of natural assets (Nassl and Löffler, 2015), and these assets, as well as their users, are embedded into complex SES.

Numerous studies emphasise that people are an integral part of SES and that a dynamic interaction exists between them and other parts of the system. The following observations have been made based on analysing SES and examining the link between their human and environment sub-systems: 1) SES are complex and difficult to quantify (Villamagna and Giesecke, 2014); 2) the realisation of non-material values of ecosystems (e.g., cultural and amenities) could promote more sustainable human behaviours (Ericson et al., 2014); 3) dependence of human society on cultural ES will likely increase in time (Daniel et al., 2012) and be more important in the future (Plieninger et al., 2013).

These observations necessitate an improved understanding of human behaviour and of governance and decision-making processes affecting complex and dynamic SES (Rounsevell et al., 2010). The role of governance and social-ecological innovation (Dennis et al., 2016; GRAID, 2017) is important for sustaining SES. If governance does not match or fit to particular characteristics of the SES, it aims to govern, it is likely to lead to rigid systems, conflicts, incompliance of the rules, and environmental problems (Young, 2002; Folke et al., 2007; DeCaro and Stokes, 2013). Examples of misfits include governance focus on single resource in complex ecosystems, command-and-control governance undermining local participation, rules and laws not accepted by

stakeholders, and lack of attention to particular features of local social systems (Holling and Meffe, 1996; Hiedanpää, 2013; Sarkki et al., 2015). Therefore, challenges to sustainability cannot be effectively coped with, if the governance responses do not take into account the particular social and ecological characteristics of SES and their interactions (i.e. if these responses are not socially-ecologically innovative).

Governance encompasses, but is not limited to policies and legislation, market based instruments, civil society initiatives and self-governance: all functioning at multiple levels, being the basis for innovative responses and adaptation (Lemos and Agrawal, 2006; Andonova and Mitchell, 2010; Wurzel et al., 2013). The adaptation measures are reflected in institutional behaviours, policies, the changing attitudes of relevant stakeholders, actions and practices aiming to enhance well-being in given situations, i.e. social innovations (SIMRA, 2016). In order to identify effective responses to challenges the SES must be studied in detail. There is also a need to identify particular/potential misfits resulting from governance failures to propose ways forward, and how the misfits as threats to sustainability, can be overcome.

Importantly, that different groups of people perceive a changing world and challenges they face, differently. Their preferences as to kinds of “final” goods and services of ecosystems may differ. People benefit from SES in different ways (Christie et al., 2007; Nijnik and Miller, 2013). Stakeholder priorities with respect to individual ES may be different either (Nijnik et al., 2017), as may be a range of stakeholders (Sarkki et al., 2017b). Therefore, human dependence upon ES at the individual, household, community and regional, and higher levels is a complex and multifaceted phenomenon (Beckley, 1998). This observation implies that interactions between social, governance and environmental sub-systems of forest SES (FSES) should be studied further in order to fill the existing knowledge gap, regarding the varying perceptions on ES benefits and values and to identify responses for enhancing equity and sustainability, particularly in marginalised rural areas, including in mountain regions.

The UN 2030 Sustainable Development (SD) Goals' 2030 Agenda (United Nations, 2015) highlighted three mountain-forest related targets: 1) target 6.6 – by 2020, to protect and restore water-related ecosystems, including mountain and forest; 2) target 15.1 – by 2020, to ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and ES with particular emphasis on forests and mountain communities; 3) target 15.4 – by 2030, to ensure the conservation of mountain ecosystems, specifically their biodiversity, in order to enhance their capacity to provide benefits that are essential for SD.

Indeed, forest ES play an important role in economic and social development of mountain regions, e.g. being a source of wood and non-wood forest products (NWFPs), a renewable energy source, and a basis for outdoor recreation, in addition maintaining their ecological significance (e.g. for watershed protection, erosion control and biodiversity conservation). Mountain forests contribute to reducing societal vulnerability to climate change and to ensuring the well-being of local, forest-dependent communities. Attention is being increasingly paid to an improved understanding of human-environmental interactions within the FSES (Kalaba, 2014; Mohammed and Inoue, 2017).

Recent studies seek to explain how forest ecosystems can contribute to the human well-being and provide sustainably a broad array of essential ES (Melnykovich and Soloviy, 2014). Forest-dependent communities, such as mountain communities in the Ukrainian Carpathians, use

ecosystems intensively because they depend on ES. Forest users and governance representatives at a local level influence the sustainability of FSES (Sarkki et al., 2017a). To date, however, mountain FSES where communities are highly dependent on goods and services derived from forests and where the human–environmental interactions remain a key factor for SD are underexplored. Sarkki et al. (2017a) provided evidence that multi-functionality in forest social–ecological interactions is a challenge to explore, since the combination of ES may be different across different locations and contexts, and dependent on a high number of factors.

Thus, it is imperative to examine the SES complexity across a range of social and environmental interactions as well as the dynamics and cross scale issues that have multiple outcomes (Nijnik and Miller, 2013). Specifically, there is a lack of understanding of the flows of ES that contribute most to the well-being of communities that are highly dependent on forests, as it is in the Carpathian Mountains (Nijnik and Melnykovich, 2016; Melnykovich and Soloviy, 2014).

Our research seeks to add to bridging this knowledge gap by contributing to the development of a better understanding of: (i) human–environmental interactions pertaining to FSES, which is crucial for the development of innovative responses to address contemporary challenges in mountain areas and enhance systems' resilience; (ii) the perception of forest by relevant stakeholders to help sustain FSES and the well-being outcomes derived from forests; (iii) diverse development trajectories and current challenges to sustainability of FSES, with (iv) identification of appropriate responses (e.g. social innovations and social–ecological innovations) - to assist in overcoming the challenges and achieving FSES sustainability at a local scale. The focus on the Ukrainian Carpathians as a case study advances both the conceptual and the practical knowledge of a FSES in order to ultimately attain a more sustainable provision of ES.

We present an overview of the framework and research methods in use, introduce the study conducted and provide its main results. We continue with a discussion of the results and conclude by presenting the scope of applicability of these research tools, outlining the ways to move forward in scientific research in the field and its implementation on the ground.

2. Materials and methods

2.1. Study area and case study sites

The Carpathian ecological region is in the geographical centre of the “European-Mediterranean Mountains Mixed Forest” distribution which is among the WWF's Global 200 Ecoregions (Vasiljević and Pezold, 2011). Mountain forests of the Carpathians have a global environmental significance for the densely populated and highly urbanized European landscapes because of their unique and rich, yet threatened biodiversity. The Ukrainian Carpathians cover about 4% of the country's territory (10.3% of total area of the Carpathian Mountain range) but produce a third of the forest resources of Ukraine (Nijnik et al., 2009a, 2009b). The average forest cover in the Ukrainian Carpathians is 42% and it accounts for 20% of the total forest area in the country. Different administrative regions have different shares of forest cover: Transcarpathia – 51.4%; Ivano-Frankivsk – 41.0%; Lviv – 28.5%, Chernivtsi – 29.4%, as compared with Ukraine's total forest coverage of approximately 15.9% (State Forest Agency of Ukraine, 2016).

The tenure rights are distributed, as follows: 86.5% of forest land is public and under the management of state forest enterprises; around 13% is communal property and only 0.5% of forests are in small-scale, private property (State Forest Agency of Ukraine, 2016). Forest land users in the Ukrainian Carpathians include state forest enterprises; local authorities (municipalities); administration of nature protected areas; tourism enterprises; agricultural enterprises, etc.

Three administrative regions ('oblasts') of Lviv, Transcarpathia, and Ivano-Frankivsk were examined to understand the people and forest

ecosystem interactions as well as to analyse the main threats for sustainability of SES in the Ukrainian Carpathians. An administrative district in each of these regions (Staryi Sambir, Khust, and Kosiv, correspondingly) was selected for an in-depth investigation. These case studies, therefore, represented three different parts of the Ukrainian Carpathians: 1) Verhnodnistrovski Beskydy, 2) Polonyny and Volcanic ranges, and 3) Pokutsko-Bukovyna, respectively.

The following criteria were used for the selection of study sites: forest as the dominated landscape; common/similar SES and the economic situation; predominance of the population residing in marginalised rural areas; much of the population has traditionally relied on forestry sector employment, primarily through state forest enterprises or private wood processing enterprises (e.g. sawmills). See Table 1 for a short description of the sites.

2.2. Methodology

According to Binder et al. (2013) more than 16 original frameworks are known to analyse SES. Through a comparison of these frameworks, DPSIR (adopted from Huber-Sannwald et al., 2012) in combination with the ES approach have been selected for analysing the FSES. The DSIR framework was used because it enables researchers to structure existing knowledge of problems and reveal key causes, consequences, effective responses, and the dynamic relationships between various SES components. Also, as ecosystem services are in the focus, the use of ES approach makes much sense. Thus, this research followed a mixed method route integrating qualitative and quantitative data collection and analyses with the application of the DPSIR framework in combination with the ES approach.

The elaborated DPSIR-ES framework embedded the knowledge obtained from the review of the relevant literature and policy documents as well as interviewing of key stakeholders residing and working in the study area. Face-to-face interviews with N = 450 representatives of forest-dependent communities in the Carpathians region of Staryi Sambir, Khust, and Kosiv districts were conducted and stakeholder workshops were held.

The theoretical and operational (DPSIR-ES) framework of our research (Fig. 1) was based on the assumption that forest SES are dynamic and their sustainability influences the quality and quantity of assets (i.e. social, cultural and natural capitals) which consist of and/or directly/indirectly contribute to the provision of supporting, regulating and cultural/social ES. Quantity and quality of ES were considered to be determined by various internal and external, socio-economic and environmental drivers to which coupled SES respond. These 'drivers' are largely illustrated in Fig. 1, but they are also related to land acquisition, non-regulated development of recreational areas (Bihun, 2005) and other challenges that go beyond the scope of this research.

The inter-connection among components of the FSES builds the system's resilience. When a variable in the complex and dynamic system exacerbates the society has to find solutions to improve and sustain the whole system. Innovative 'responses' to address challenges were examined via the application of DPSIR-ES, which was used as a guide to identify different components of forest SES and their interactions linked to the well-being of communities and as an instrument for identifying current drivers and finding appropriate solutions ('responses') of how we can possibly enhance the sustainability of FSES (Sarkki et al., 2017c). The main responses (i.e. potential solutions identified through stakeholder engagement) are also illustrated in Fig. 1. These responses are not exhaustive. We can add to the examples seen in Fig. 1 also subsistence farming which is the most important response to unemployment and rural poverty in the study region.

The research was conducted in the following phases (Fig. 2.).

Phase I. The review of relevant literature formed the starting phase which provided an overall understanding of the state of affairs in a FSES in the Ukrainian Carpathians. Based on the developed knowledge, an integrated DPSIR-ES framework was elaborated for this particular

Table 1

Study sites description.

Source: The State Forest Agency of Ukraine, 2016; Chernyavskyy et al., 2011.

Study site	Stryi Sambir district, Lviv oblast	Khust district, Transcarpathia oblast	Kosiv district, Ivano-Frankivsk oblast
Characteristics			
Part of the Ukrainian Carpathians	At foothills of the Verhnodnistrovski Beskydy (upper part of the Dnister river basin)	At foothills of the Polonyny and Volcanic ranges	At foothills of the Pokutsko-Bukovyna
Elevation	Lowlands: 350–450 m above sea level. Mountains: 700–950 m	Lowlands: 180–400 m above sea level. Mountains: 700–1000 m	Lowlands: 300–450 m above sea level. Mountains: 700–1000 m
Highest elevation	Magura (1022 m)	Lak (1134 m)	Hrehit (1472 m)
Area	1245.17 km ²	975 km ²	986 km ²
Population density (average)	69 persons/km	97.8 persons/km	89.6 persons/km
Population			
Total	78,045	95,723	88,182
Rural, %	77%	91%	83%
Urban, %	23%	9%	17%
Settlements (including administrative centres)	110 villages, 2 urban type villages, 3 towns	56 villages, an urban type village, a town	42 villages, 2 urban type villages and a town
Common economic activities	Trade and services, agriculture, forestry, small and medium enterprises related to forestry/wood processing, and tourism	Forestry, small and medium enterprises related to forestry, wood processing, agriculture (with vineyards), trade and services	Tourism (eco/green/agro), trade and services, forestry and agriculture, wood processing, hand-made woodcrafts, etc.
Landscape	77.5% - uplands and mountains mostly forested, other - lowlands suitable for agricultural activities (primarily as pastures and subsistence farming)	60% - mountains forested areas with <i>polonynas</i> - Alpine or sub-alpine meadows at the top (mostly pastures) and plain-terraced river valleys - agricultural land (mainly used for fruit gardens, vineyards and subsistence farming)	56% - mountain areas mostly forested with <i>polonynas</i> - Alpine or sub-alpine meadows at the top; 44.0% of the agricultural land which is used mostly for subsistence farming
Forest cover (%)	40.0%	40.0%	50.6%
Main forest species	Pine, spruce, fir, oak, and beech	Mainly beech and oak	Mainly beech and pine
Forestland tenure/management rights	<ul style="list-style-type: none"> • Stryi Sambir state forestry and hunting enterprise (under the State Forest Agency of Ukraine) • Stryi Sambir agricultural forest enterprise "Galsillis" (under the Ministry of Agricultural Policy) 	<ul style="list-style-type: none"> • Khust state forestry enterprise (under the State Forest Agency of Ukraine) • Khust experimental State forestry enterprise (under the Ministry of Agricultural Policy) • Khust Forest Technical College 	<ul style="list-style-type: none"> • Kutske State forestry enterprise (under the State Forest Agency of Ukraine) • Kosiv regional agricultural forest enterprise "Rajagrolis" (under the Ministry of Agricultural Policy) • National Natural Park "Hutsulshchyna" (under the Ministry of Ecology and Natural Recourses)
Main forest related activities of local residents	NWFP, grazing, wood-processing (sawmills), tourism (not well developed)	Wood-processing (furniture), NWFP, grazing, Tourism (green/eco), Farm/homesteads for eco/agri-tourism	Tourism (green/eco/agri-), Farm/homesteads for eco/agro-tourism, Wood-processing (mainly woody handicrafts), hiking, skiing, biking, NWFP, grazing, willow basket weaving
Protected areas	Regional Landscape Park "Verhnodnistrovski Beskydy"	National Natural Park "Synevir", Part of the Carpathian Biosphere Reserve "Kisheri"; Part of the Carpathian Nature Reserve "Valley of the Daffodils"	National Natural Park "Hutsulshchyna"
Main water resources	Dnister and Stryvior rivers	Tysa, Tereblja, and Rika rivers	Cheremosh, Pistynka, Rybnica, and Lyuchka rivers
Ethnographic group, which maintains cultural heritage and resides in the area	Predominantly Boyky	Predominantly Lemky	Centre of Hutzul culture
Border with other countries	Poland	Romania (the Transcarpathian region borders with Poland, Slovakia, Hungary and Romania)	Border with Verkhovyna district, which borders with Romania

case and the following four issues were identified to be of major importance for our research: (i) human-environmental interactions pertaining to FSES; (ii) the perception of forest by relevant stakeholders; (iii) current challenges of FSES and (iv) plausible policy and governance responses to assist in achieving FSES sustainability at a local scale.

Phase II. Qualitative data collection - 'face-to-face' interviewing. The rationale for the selection of respondents was based on an adequate level of competence, which was evaluated using the following criteria: i) employment requiring special training in the field and maintenance of the positions in corresponding organizations; ii) stakeholders' residence within the case study region; iii) awareness of the situation and active social position. The following three categories of respondents who were most relevant and aware of the situation in each case study site were identified: i) forest related business representatives; ii) forestry specialists; and iii) local community representatives. Based on an extensive literature review (in Phase 1), three questionnaires were

designed for each category of respondents. We interviewed (using semi-structured interviews) 150 respondents in each case study site (50 forest related business representatives, 50 forest managers, and 50 residents in forested areas and communities' representatives) for a total number of 450.

Phase III. Participatory techniques were applied with the purpose of better understanding stakeholders' opinion on the research questions and find "a draft" of possible responses by society at a local level to overcome the challenges and achieve FSES sustainability. We organized a stakeholder workshop in each case study site with a wider involvement of regional governance representatives, NGOs, media, representatives of forest industry, small businesses, community representatives, as well as scientists.

Phase IV. A subsequent application of quantitative methods: PCA and statistics using the Statistical Package for Social Sciences (SPSS) was performed. The application enabled us to identify and analyse associated stakeholder attitudes and perceptions of current challenges

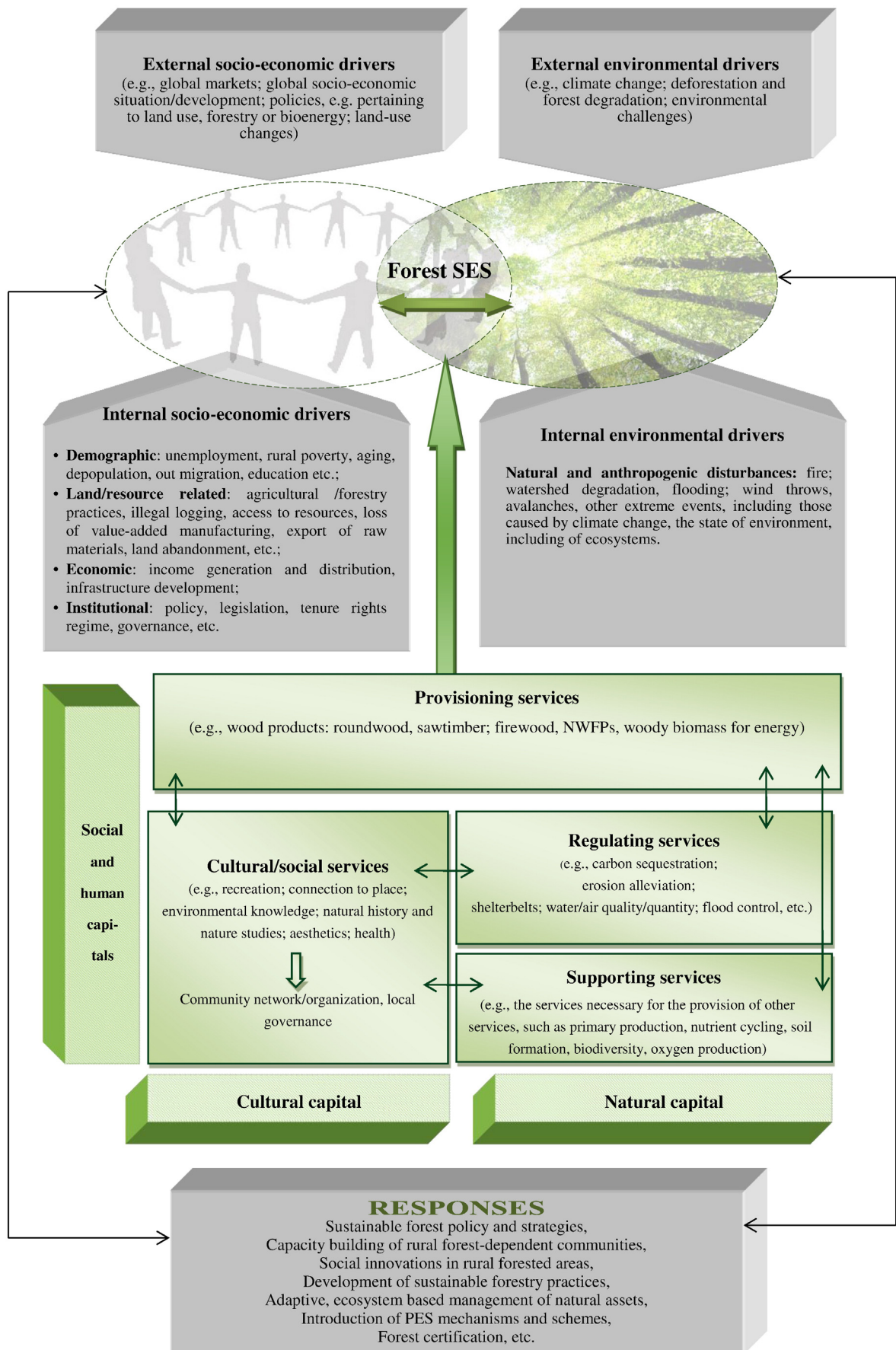


Fig. 1. The conceptual framework of research. (Source: adapted from Huber-Sannwald et al. (2012)).

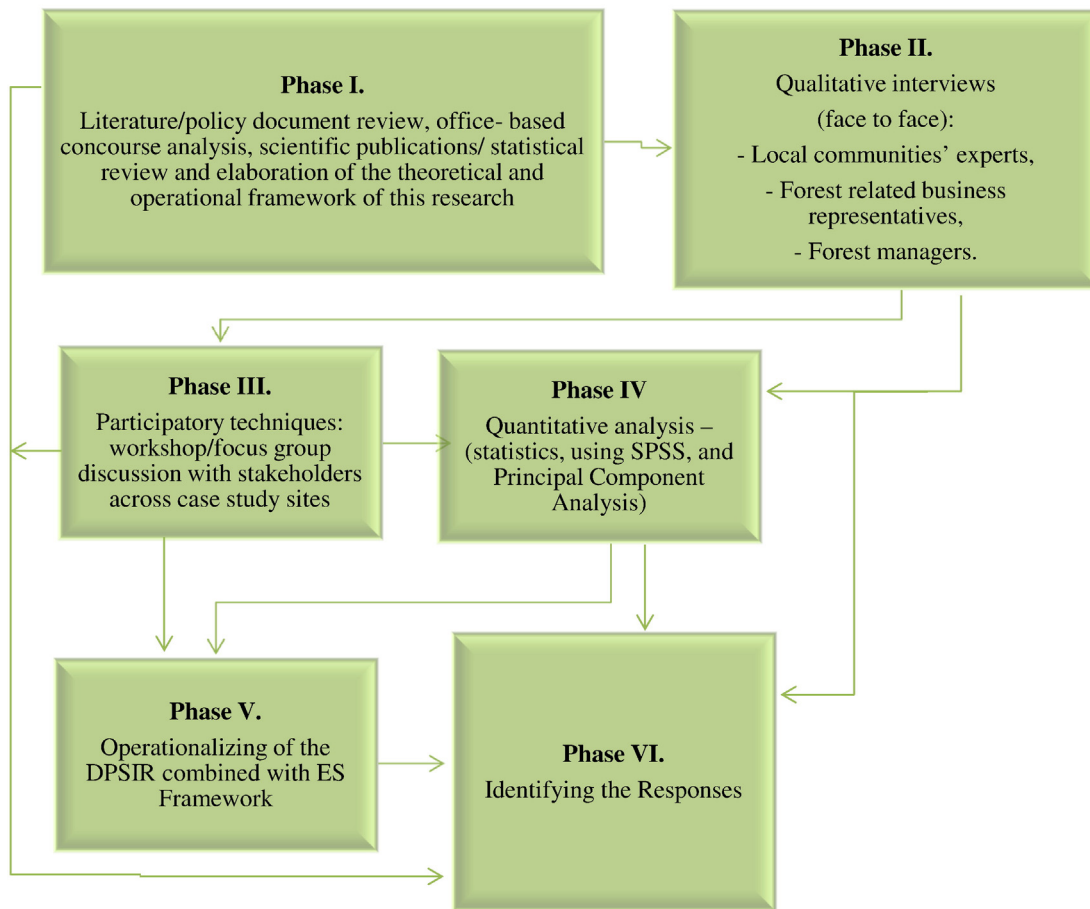


Fig. 2. Logical frame of knowledge flow, main phases and the sequencing of research.

('drivers') in forest SES in the Ukrainian Carpathians and their potential solutions ('responses').

Phase V. Based on the information obtained in the earlier phases, our improved knowledge of the FSES and an application of the DPSIR- ES theoretical and operational framework, we specifically advanced the understanding of: (i) Drivers (ii) Pressures (iii) State of the FSES; (iv) Impacts caused by changes occurring and (v) the Response to these changes and possible ways to adapt and to enhance the FSES resilience.

Phase VI. An in-depth understanding of the Responses was developed and their discourse analysis carried out by taking into consideration a range of current and FSES relevant policy and governance trends, including of social-ecological innovation, meaning "the Response of social-ecological systems to the Drivers-Pressures-Impacts imposed challenges through the reconfiguring of ecological processes and societal (including economic) practices, which seek to enhance social and environmental outcomes and necessarily includes the engagement of local communities."

The results of the six phase analysis are structured in the following section in a following manner. Firstly, we present insights from the literature review. Then, we outline stakeholder evaluation results of important components of the FSES for local people and preferences on various ES delivered. Next, the results from quantitative analysis of interviews, workshops and DPSIR assessment are used to identify key sustainability challenges to the FSES. This analysis resulted in finding the key challenges related to community access and user rights on forest ES, and illegal loggings. These issues are explored in-depth. Finally, discourse analysis on existing legal and policy frameworks is used to identify plausible solutions or responses to the challenges. Furthermore, this analysis is extended in discussion to tease out additional responses

deriving from international experiences in policies and governance instruments, including social innovations, aiming to enhance sustainability of the FSES.

3. Results

3.1. Evidence from the literature survey

A desk-based literature survey, combined with our visits to the case studies and meetings with key informants have provided empirical evidence that, in the Ukrainian Carpathians, mountain communities were historically dependent on maintaining of an ecologically balanced environment with the use of forest resources for daily life. Forest-dependent communities strongly rely on firewood, fencing, home building materials, food from plants and animals – NWFP (which have seasonal and cyclical yields), forage for cattle, and income through employment in the logging industry, tourism and recreation, and other intangible benefits (seen also in Egan et al., 2017; Chernyavskyy et al., 2011), i.e. multiple ES.

Wood is currently regarded as the most important forest product. Forestry and wood processing enterprises are the main local employers. In some localities, small sawmills and wood processing enterprises have social rather than economic character assisting in the prevention/alleviation of local unemployment and providing people with firewood for very low prices. However, many of these businesses are illegal. Overall, rural residents are commonly experiencing decreasing standards of living (seen also in Elbakidze and Angelstam, 2007). NWFP, such as mushrooms, berries and game, as well as medicinal herbs are additional vital resources for self-subsistence and supplemental income.

The dependence on the forest, however, causes a number of drawbacks including: low income generation, poor level of entrepreneurship, low employment level (resulting in illegal logging), high labour migration and decline of rural population, as well as weak institutional support with little stakeholder participation in the decision-making (Fig. 1).

The Ukraine's Carpathians are characterized as cultural landscapes reflecting long-term interactions between local people and the natural environment. Forests have high environmental and spiritual values for marginalised rural communities and are important for their well-being (Synyakevych et al., 2009). The region offers an exceptionally rich natural and cultural heritage that is the basis for tourism development. The cultural heritage is closely tied to the landscapes, species and natural processes. Tourism is becoming an important source of additional income (e.g. guest rooms, guide and transport services to remote areas for skiing, hiking or horseback riding).

Agricultural activities are almost entirely self-sufficient and the technologies in use are comparatively basic (without high technology and with sporadic use of fertilizers and pesticides). Pigs, goats, sheep, dairy cows and cattle are used for self-subsistence or are sold locally. Traditional agriculture and livestock remain the basic sources of food for people. The fodder is grown in the garden and hay is mown on meadows adjacent to the house or upland pastures in the mountains.

However, the research findings indicate that, in addition to traditional knowledge and local practices, the relevant knowledge co-constructed with stakeholders is needed to bring smart solutions to marginalised rural areas. Moreover, to enhance the resilience of FSES, social innovations and adaptation strategies need to be implemented.

3.2. Forest social-ecological system: stakeholder evaluation

Respondents reported that the forest is important or very important for their life as a natural phenomenon or a protected area (93.6% of all asked). It is important for NWFP (91.6% of respondents), recreation (82.3% of respondents) and a source for commercial timber and firewood (59% and 54% of respondents, correspondingly). The survey results confirmed the hypothesis about the important role of forest products and ES for forest dependent communities (Fig. 3).

The well-being of local communities appears to be directly and positively dependent on sustainability of the forestry sector (e.g. sustainable forest management - SFM, in Elbakidze and Angelstam, 2007). The communities are also strongly dependent upon forest supporting ES, e.g. soil formation, or regulating services, water regulation and flood control. This is likely because the current state of forest is conditioned by the level and intensity of anthropogenic influence as well as by the growing urban and industrial pollution, which impairs the resilience of the FSES. In some localities, the pressure on forests has caused ecosystem instability. During the last decades the number of fires and size of burned areas has increased. Unregulated forest harvesting has contributed to a number of devastating floods which caused severe

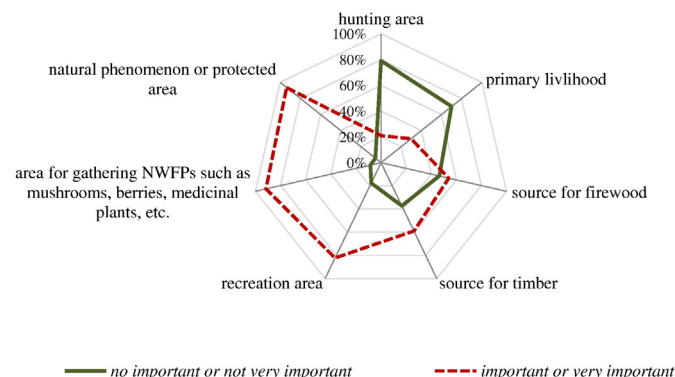


Fig. 3. The meaning of forest for local communities' members in case-study sites.

damage leading to the subsequent social and economic problems in the analysed region (Roth et al., 2008).

Key results of stakeholder evaluation on the importance of forest ES for local people are illustrated in Fig. 4. Forests contribute to a sense of identity for members of a local community. Forests play an important role in carbon sequestration and in the maintenance of hydrological systems. Although not marketed, these ES are globally relevant and exported.

NWFPs provide tangible economic and social benefits to rural communities. From socio-cultural perspectives, the use of NWFPs has a long tradition in many forested countries, reflecting the local knowledge and social practices that are worth conserving. Since recently, the interest in recognising the value of NWFPs and their role in supporting the well-being of many people has risen substantially. Because NWFP often contribute critically to the well-being of forest-dependent communities, sustainable management and use of NWFP are to be important parts of SFM.

3.3. Challenges and threats to the FSES sustainability

Global climate change, land-use change, the expansion of tourism and a deteriorating socio-economic situation pose serious threats to sustainability of mountain areas. Abandonment of agricultural land and changes in traditional land use systems as well as rapidly growing and often unsustainable recreational development are observed in the studied region (also seen in Elbakidze and Angelstam, 2007). Changes in marginalised rural areas are often directly related to unsustainable forest practices and overexploitation of resources. The challenges to SD in the Ukrainian Carpathians (some mentioned earlier and presented in Fig. 1 and in Nijnik, 2004) include low income levels, unemployment and job losses, limited educational opportunities, depopulation of rural areas, inadequate funds for SFM and illegal logging. These factors consequently decrease forest productivity, which, in turn, compromises watershed functions and the overall stability of fragile mountain ecosystems. Among the problems there are also unsanctioned land acquisition and unregulated development of recreational areas by outside businesses that at times ignore local cultural traditions, including traditional landscape planning and land use systems. There is minimal monitoring and enforcement by the local authorities to ensure that forestry enterprises comply with environmental regulations. In addition, illegal resource harvesting is a serious threat to the productivity and stability of forest ecosystems.

According to respondents the main drivers which pose the highest threat to the FSES are (Fig. 5): corruption and illegal timber harvesting (83.3%), illegal logging by local residents (80.7), ineffective and unsustainable exploitation of forest resources because of the decisions imposed by local businesses (80.3% of respondents) and transfer of forest

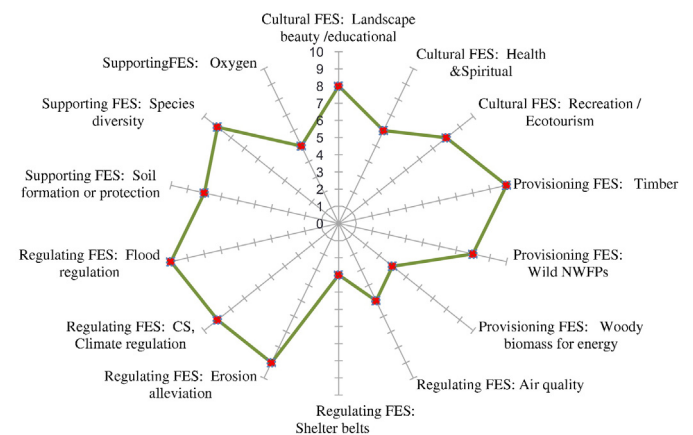


Fig. 4. The stakeholders' evaluation of the importance of forest ES for local people (importance is estimated by using 10 point Likert scale).

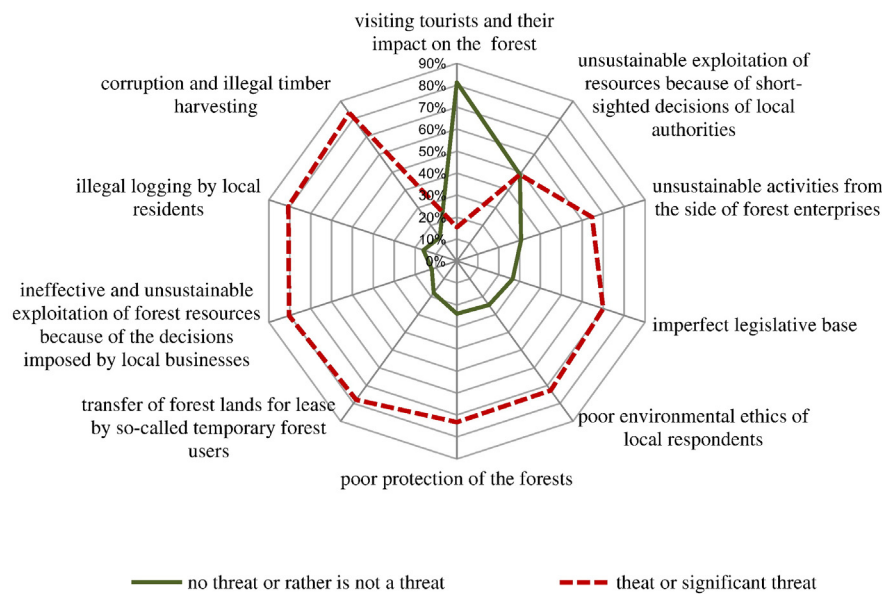


Fig. 5. Key drivers for threats to FSES sustainability in the Ukrainians Carpathians.

lands for lease by so-called temporary forest users (78%). The high threat to the FSES is also caused due to poor protection of forests (73.3%). Other drivers threatening the FSES concern the unsustainable exploitation of forest resources because of the poor environmental ethics (72.7%) and an imperfect legislative base (70%), with other challenges to forest ecosystems as seen through the eyes of our respondents, also illustrated in Fig. 5.

While discussing the drivers seen in Fig. 5, the respondents were inclined to 'shift the responsibility' on the 'objective situation in the country' and put the culpability on factors which were beyond their direct control, including poor economic performance, a shadow economy, corruption and an insufficient level of social care.

3.3.1. Community use and access rights to forest

The Forest Code (2006) is the main forest policy document in Ukraine (e.g. allowing the public to openly access forests, with the use of forest resources being regulated by a number of corresponding rules and legislative documents). Because forest-dependent communities rely substantially on the forest an important factor in ensuring their well-being is their access to forest resources. In this paper, we analysed how easy the respondents think it is to get a legal access to obtaining forest products including of wood and NWFP, and grazing rights.

When we asked how easy legal access to commercial timber was 56% of community members responded that it was difficult but possible to get wood lawfully, and 34% responded that they did not face any significant problems with the legal access. Community members reported that they obtained timber for construction and household needs through forest enterprises (officially) – 45.1%; bought it from local villagers (willingly produced) – 15.7%; through intermediaries (enterprises and individuals) – 15.7%; through forest managers (unofficially) – 13.7%; independently – 5.9% and through village councils – 3.9% (they were asked to select no more than three options).

Representatives of forest-dependent communities reported that they did not face significant problems with legal access to firewood (56.9%) and 39.2% of respondents admitted that it was difficult but possible to get wood in officially. Only 2% of community members responded that it was impossible to get wood in a legal manner. The highest number of respondents obtained firewood through official permits from forest authorities (75.9%). Some of the interviewed participants used to buy firewood from other local community members (15.7%); and 13.7% independently harvested firewood in a nearby

forest. Only 2% of respondents received firewood as a social service from state forest enterprises.

Community members reported that they had no problems with legal access to collect mushrooms, berries, fruits and herbs (90.2% of respondents). About 7.8% of the interviewed participants have some restrictions and one respondent admitted that he had no legal rights to gather these products in forests.

When we analysed to which extent the community access to hunting was limited, the picture appeared to be as follows: 66% of respondents had some restrictions to access, 20% - did not have significant problems with legal access to hunting, and 8% - had no legal rights.

Free access of local forest-dependent community members to recreation and tourism is an important factor in ensuring their well-being. 70.6% of community members responded that they did not face problems with legal access and 21.6% admitted that there were some restrictions.

Because many people have households with cows, sheep and horses, a very important factor for the community well-being is free access to livestock grazing. Community members reported that they did not face problems with legal access (54.9%). However, occasionally there were some restrictions (39.2%); while 2% of respondents always faced restrictions.

We have also found out that the current laws do not offer an appropriate means for legitimately ensuring transparent processes of stakeholders' participation in forest resource planning and management (c.f. Nijnik and Oskam, 2004). This circumstance contributes to the poor awareness by local residents of their rights to access and management natural resources. This contributes to a lack of mutually beneficial cooperation between communities and forestry managers, consequently impeding an increase in the local communities' well-being.

3.3.2. Illegal logging as a threat to sustainability of the FSES

The finding provided evidence that locally, unsustainable forest use and illegal logging persist, resulting in a continued loss of old-growth, encroachment on protected areas, loss of natural forests and their services as well as in the ongoing fragmentation of Europe's last large mountain forests (also seen in Kuemmerle et al., 2009). Illegal logging and an unsatisfactory level of attention paid to the interests of local communities have been identified as key unsustainable forestry practices in the study region. Forest-dependent communities identified the following main causes of illegal logging: low level of social standards; high unemployment rate; functioning of illegal private sawmills; high

profitability of illegal logging; insufficient measures to combat smuggling and corruption, and presence of a shadow sector in economy. Forestry professionals and business representatives admitted that illegal logging is the main factor adversely affecting the FSES. The illegal logging causes the following main socio-economic consequences:

- i. deterioration of living standards due to the depletion of natural resources (reduction in the level of economic and social well-being of forest-dependent communities);
- ii. social conflicts over resource distribution inequality against the principles of SD (concerning social injustice as to the allocation of resources within generations and inequity in the distribution of resources between generations);
- iii. budget deficit and financial losses to the state and local budgets, reflected in social programs (education, science, culture, security);
- iv. increase of the expenditures for the cultivation, protection and restoration of forests;
- v. reduced feedbacks between state investment in forest cultivation and the collection of revenues from timber harvesting (profits are going to those who harvest illegally).

Environmental implications of illegal harvesting include: loss of biodiversity, climate change implications, natural disturbances (e.g. soil destruction, intensified erosion processes, disturbances in hydrological regimes, due to unfavourable harvesting technology), decrease in stability of the ecosystems, decline in the protective functions of forests (e.g. resulting in a greater risk of floods), pollution of rivers and roads by slash or wood residues. Deficiencies in the forest control system, which is caused by a broad-scale illegal clear-cutting result in: breaking the law on harvesting operations, corruption, conflicts between interests of different agencies, lack of progress in implementing the concept of SFM (Nijnik, 2004).

Respondents from local forest-dependent communities were asked how active they were in the protection of forest resources from illegal harvesting. Respondents answered as follows: rather passive than active – 35.3%; rather active than passive – 21.6%; completely passive – 19.6%; very active – 3.9%; and difficult to answer – 19.6%.

Community members highlighted the following points as crucial for forest protection from illegal logging based on the community involvement (Fig. 6): control of timber harvesting and transportation of roundwood, control of timber harvesting for firewood, access to information about forest management planning and practices, organization of community meetings on the key issues of forest management and community participation in forest related decision-making, as well as engagement in the process of forest management certification (FMC).

The following courses of action needed to prevent or decrease illegal logging, have been identified in the course of this research: reducing unemployment and increasing human welfare, increasing penalties for illegal activities, enforcing administrative and criminal liability, enforcing



Fig. 6. Crucial points for forest protection highlighted by stakeholders in the Ukrainian Carpathians.

public control of forest use, forest certification, and wider community participation in forest planning and management. Legally mandated investment in mountain livelihood strategies, if properly implemented, could strengthen local communities and reduce out-migration and lessen the pressure on fragile resources such as forest and farmland.

Community-based forest management is seen as a property rights regime that enables rural communities to directly benefit from forests and can lead to greater participation, reduced poverty, increased productivity and diversity of vegetation and the protection of forest species. During the survey process, local community members were asked about their expectations for perspective outcomes if the community would have more rights in SFM planning and timber harvesting activities (Fig. 7).

The results show pessimistic expectations which can be explained by the lack of management skills and the legacy of the former collective (*kolhoz* and *sovhoz*) types of land tenure which proved to be unsuccessful. The study obtained empirical evidence to suggest that in order to achieve the more efficient and sustainable use of forest resources and increase the level of well-being of forest-dependent communities, at a local level, the following action points were recommended:

- a) create community groups of the most competent people who have potential to be influential in the forestry related decision-making (56.9% of respondents);
- b) increase the level of environmental awareness through information and knowledge sharing and mutual learning;
- c) advance the legislation for SFM (55%);
- d) develop an understanding of community members about their potential to be influential in the decision-making (47%);
- e) increase social cohesion and order, and.
- f) build community spirit and trust, advance social innovations and develop end-user capabilities to manage their own affairs (37.3%).

4. Discussion

According to the results of this paper, the key challenge to sustainability of FSES in the Ukrainian Carpathians is the illegal timber harvesting as well as excessive gathering of berries and mushrooms both for personal consumption and for sale. The simplest, but most narrow and biased explanation would be that the local people practicing illegal logging do not respect laws and regulations but aim to exploit the system as much as they can for their individual benefit. Such an explanation would put the blame for unsustainable practices on local people (c.f. Robbins, 2004). The next step in searching for explanation would be to accuse still remaining unreformed elements of the Soviet style command-and-control system that cares primarily about national government interests at the expense of local communities. The forestry sector is very conservative and reforms proceed slowly (Nijnik and van Kooten, 2000, 2006). Therefore, changes are not as radical as, for example, in the agricultural sector (Soloviy and Cubbage, 2007).

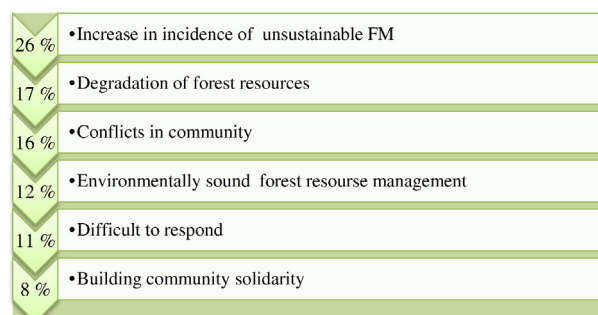


Fig. 7. Expectations concerning the outcomes if the community would have more rights in forest planning and management.

Also verified and illustrated by our findings was the second major problem for sustainable governance of FSES – that local people either had no rights (or were not aware of the rights that they formally have) to access the forest resources (such as timber or fuelwood) which are deemed to be crucial for sustainable livelihoods. They also have limited possibilities for implementing social-ecological innovations and making a difference in the decision-making. Therefore, it is fair to say that existing governance rules and systems do not fit with the local needs leading to a number of challenges to sustainability (Fig. 5).

This relates to a more general problem, according to which natural resources are likely to be used unsustainably, if the governance systems do not fit with the SES they intend to govern (Young, 2002; Folke et al., 2007). Nonconformities or “misfits” are likely to lead to pathologies and rigidity traps in resource governance (Holling and Meffe, 1996; Carpenter and Brock, 2008), in compliance with the rules (Hiedanpää, 2013), conflicts between stakeholders (McAfee and Shapiro, 2010), and ecologically harmful activities (Folke et al., 2007). To enhance the fit between forest governance and FSES, the general mismatch between command-and-control governance and local stakeholder engagement needs to be analysed in further detail in order to address the community members' concerns and aspirations in using forest ES. Next, we provide the following five assumptions backed up by our results on such misfits that are currently undermining the sustainability FSES. We also discuss ways how these misfits could be overcome.

4.1. Misfit 1: spatial misfit in legislation

The continuing command-and-control type of legal framework for forest governance in Ukraine puts its main focus on national economic benefits, undermining socially and ecologically sustainable use of forest ES for local benefits. Results showed that local communities considered the lack of rights to use forest resources as a problem. This is due to out-of-date legal frameworks regulating the use of forests: the imperfect legislative base was seen by our respondents as a key threat to sustainable use of forest ES (Fig. 5). Therefore, the current laws are ineffective to promote sustainable FSES at a local level. We interpret this to reflect a spatial misfit (Wandel and Marchildon, 2010; Moss, 2012) between the focus of Ukrainian legislation on national level benefits (Nijnik and van Kooten, 2006) and its missing attention to sustainability of FSES on the ground.

A solution would be to refine the legislation towards a more sustainable forest management taking account of the problems existing at a local level. However, imposing more and stricter rules may not work well, because they are not likely to take away the problem of noncompliance, unless there is a costly monitoring system, which would take the command-and-control governance even further (Holling and Meffe, 1996). Furthermore, if under the existing governance system, the current legal focus on national level economic benefits could be changed to address primarily environmental considerations with a rising interest in bioenergy and the development of green economy (Baidala, 2016), it is likely that local use access rights to forest resources would not be enhanced anyway, and the shift would lead to implementation failures (see Howes et al., 2017). Therefore, we assume that increasing control would not ease the misfit. On the contrary, there are ongoing developments for implementing integrative and collaborative reforms in forest governance and enhancing social innovations (SIMRA, 2016) that could help to overcome the spatial misfit in legislation. Especially, after the Revolution of Dignity in 2014, the government has changed its political course towards the implementation of reforms in Ukraine's forest governance aimed at European integration (Kovalenko et al., 2017). The process is ongoing, but little concrete transformations have been achieved to change the complicated old authority-led governance and centralized, state-based rules for natural resource use and timber harvesting.

4.2. Misfit 2: poor contextualization

Due to illegal timber harvesting, local people are considered threats to sustainability rather than its actors with whom sustainability should be co-defined and practiced. Illegal logging is one of the most pressing problems for sustainable use of forest ES (Fig. 5). The extent of local illegal logging may easily lead to seeing local people as a threat to sustainability, as they do not comply with existing regulations. This can be conceptualized as a misfit resulting from poor contextualization of local realities by governance. In our study, community members identified the following main causes of illegal logging: low level of social standards; high unemployment rate; functioning of illegal private sawmills; high profitability of illegal logging; insufficient measures to combat smuggling and corruption, and presence of a shadow sector in economy. This finding stresses that, before accusing locals of this problem, the wider socio-political context needs to be understood to better comprehend the motives of illegal actions on local environments (Robbins, 2004; Nygren and Rikoon, 2008). Therefore, to enable a better fit between the forest governance and local FSES, the complexity and key characteristics of local social systems should be taken into account, for example, the high unemployment rate and rural poverty (see Sarkki et al., 2015).

When governance fails to satisfy local needs, the marginalised people may not remain passive actors, but become enablers and social innovators, aiming to enhance their well-being in given social and political conditions. In this case, illegal activities are an example of “weapons of the weak” (Scott, 1985). Thus, as a step to narrow the gap between people and current administration, it would make sense to acknowledge that local people should have the right to sustainably use the local ES (Pascual et al., 2014; Sarkki et al., 2017b: social equity) and their involvement in taking decisions on using local resources is to be a legitimate part of any democratic governance system (Ribot, 2002).

4.3. Misfit 3: trap of the single ecosystem service

The results indicate that industrial and illegal loggings offer the best short-term revenues even if they deteriorate other forest ES. This leads to “a trap of the single ES”, where various other ES deteriorate due to the exclusive focus on a single ES. The trap of this, single ES has also its temporal dimension when the single ES provides short-term benefits while leading to the decline of other ES in the long-term and thus leading to unsustainability of FSES (see Folke and Chapin-Olsson, 2009). Thus, there is a need to change the incentive structure from gaining short-term profits from illegal loggings to alternative and more sustainable ways of getting income from forest ES. In fact, the Ukrainian case informs such a shift by stressing that many regulating ES were considered to be as important for the local people as timber (provisioning service) (Fig. 4). This highlights a trade-off between gaining immediate benefits from provisioning services and having a continuous flow of benefits from regulating (and cultural services) into the future (see Spierenburg, 2012; Howe et al., 2014).

An alternative way to gain benefits from timber while not deteriorating regulating and cultural ES is to convert to traditionally-used continuous cover silvicultural systems or to close-to-nature forestry. These forest management systems are still experimental, and in the last decade have been in an implementation stage in the Ukrainian Carpathians (Krynytskyy and Chernyavskyy, 2016). If implemented with local inputs, these silvicultural systems could enable various subsistence activities for local people as an alternative to illegal logging. The trap of timber as a single ES could be overcome by better realising that people in rural areas often depend for their subsistence on multiple activities, which are in synergy with a continuous cover forestry. Therefore, local people would have an important role to play in FSES governance by complementing the technical knowledge of forestry specialists. Local people could inform forest governance by sharing knowledge of traditional practices of using multiple forest ES and

simultaneously offering insights into multifunctional uses of forest ES, e.g. through small-scale forestry development (Nijnik et al., 2009a, 2009b). Therefore, the preservation and application of traditional local knowledge can support long term sustainability of the FSES (Kluvankova and Gežík, 2016; Parrotta et al., 2016).

4.4. Misfit 4: participatory misfit

In Ukraine, experts and policymakers make decisions in non-transparent ways without providing much space for participation of local people who encounter legal obstacles to benefit from the ES in their area (Bizikova et al., 2012). The Ukrainian case is characterized by inaccessible bureaucracy and people alienated from governance leading to ineffective governance manifested by illegal activities (Nijnik and Oskam, 2004). This situation is conceptualized as a “participatory misfit”. We build on the idea that well-functioning participatory governance can help in gaining social fit (i.e. institutional acceptance) by acknowledging local social conditions that can, in turn, result in comprehensive fit between governance systems and SES enabling long-term environmental and social sustainability (Young, 2002; DeCaro and Stokes, 2013).

It has been proposed that multi-level governance systems that integrate holistic community level planning to the designing of forestry plans by the principle of “planning for people with the people” should be developed (Foellmi and Schwitter, 2009). Such an approach would enable policy actors to identify the interests of local communities and assist in avoiding or managing potential conflicts. A way towards the “planning for people and with people” could be advanced by polycentric multi-level governance systems involving e.g. state and regional administrations, forestry experts, local communities, and certification, wood products industry and environmental NGOs (see Ostrom, 2010; Sarkki et al., 2015).

However, as demonstrated in Fig. 7, local people did not perceive that there would be substantial benefits, if the local rights and participation were improved. Furthermore, capacity building, increasing knowledge sharing and environmental and ES education are needed in order for the local people to see the benefits of their engagement (see Fig. 6). Therefore, we can argue that in cases with a long history of command-and-control governance, new civic actor engagement processes to enhance participatory fit and promote institutional acceptance need to be preceded by capacity building activities for people to understand what participation is, what it can provide to them, and what can be its benefits.

4.5. Misfit 5: robbing the commons

The occurrence of illegal logging in the case studies in the Ukrainian Carpathians stresses that under the current governance system the logic to benefit and use the ES is based on maximizing individual benefits at the expense of long term sustainability of the FSES. Exploiting the FSES for individual benefit is due to poor control and monitoring processes put in place, as well as due to the lack of effective sanctioning of illegal activities (Fig. 6). We call this social dilemma as “robbing the commons”. It builds on a form of the “tragedy of the commons” where individuals utilize a system for their short-term benefits and at the collective expense (Hardin, 1968). Solutions to such a tragedy have been proposed, including increased monitoring and control of the use of common pool resources (Basurto and Ostrom, 2009), local collective systems of self-governance (Ostrom, 1990), and privatization (Hardin, 1968). Additional control cannot be considered as the most preferable option because it would mean returning to an outdated, Soviet-style governance regime (Nijnik, 2004). The self-governance is also problematic, as highlighted in Fig. 7, with some pessimistic views expressed on the expected benefits resulting from increasing local rights and enlarged participation. Also, privatization would likely lead to various problems (Mayer and Gereffi, 2010; Szakonyi, 2013).

However, market-based instruments that do not require privatization, like certification, could be a solution that can enhance the democracy and sustainability of forest governance (Auld et al., 2008; Bäckstrand et al., 2010). By introducing market-based instruments such as the “selling nature to save it” logic, offer a possibility to change the rationale of how individual and collective benefits from forest ES are currently thought about (McAfee, 1999). Increasing the share of forests under FSC certification could help illustrate how collective action and participation present opportunities to gain access to new markets, where companies require ecologically and socially sustainable forest products.

The FSC national standards for Ukraine, which are being revised, take into consideration biodiversity, water and soil, and other forest ES. In addition, special attention is being paid to social issues of SFM and stakeholder engagement in the decision-making (FSC, 2015). This will be relevant because, as confirmed by our findings, forest certification is, to date, among the most reliable tools of ensuring that the transparent and comprehensive mechanisms to enhance SD are put in place (Chernyavskyy et al., 2011). Therefore, the misfit regarding “robbing the commons” could be eased, if market actors address sustainability and participation in the production of timber through the provision of incentives for socially and ecologically sustainable use of forest ES.

5. Conclusions

This research contributed to an improved understanding of positive impacts that the Carpathian forests have for the environment and people. The integration of research tools proved to be helpful in this particular setting and could be applied in similar contexts elsewhere.

The knowledge of experiences and trends, opportunities and challenges of sustaining the FSES in the region has been advanced. It was shown that with the emphasis on participatory approaches and capacity building, a more active end-user involvement is possible in the assessment and implementation of multifunctional forestry as a policy priority for sustainable rural development in marginalised areas.

The findings from our case studies indicate that the mix of forest ES varies over space, but adapting to external and internal drivers appears to be a common challenge in the Ukrainian Carpathians. Sustainability of the FSES requires high levels of stakeholder competence and capacity-building in forest policy, land use planning and resource management. Strengthening partnerships of science, policy and practice will assist forest policy and management to maintain and improve key ES and enlarge support for mountain communities living in the area.

Community members expressed interest to contribute to designing and implementing policy measures that address sustainability in the provision of ES and improving of human well-being. However, the priority of day-to-day activities of local residents are to find additional sources of income, because the high rate of unemployment and low level of entrepreneurship are common in the region. Thus, important questions that merit further attention include: i) how to foster the resilience of ecosystems to meet the SD goals of the community, and ii) how to properly balance the long-term sustainability considerations with the short-term priorities of local people to satisfy their daily needs.

Acknowledgement

We are grateful to the Scottish Government who supported this research through their Rural Affairs and the Environment Strategic Research Programme, for the support to the project on Social Innovation in Marginalised Rural Areas (SIMRA) provided from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement No 677622, to the ENPI -FLEG II Program and to participants in our research events. We would also like to acknowledge that this article is based upon the work carried out within the Cost Action ES1203 SENSFOR (Enhancing the Resilience Capacity of Sensitive Mountain

Forest Ecosystems under Environmental Change) and the COST Action FP1203 on Non-Wood Forest Products supported by the European Cooperation in Science and Technology.

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