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**The concept of forest ecosystem services – support for forest
management decision in the Republic of Moldova**

SUMMARY

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LIST OF ABBREVIATIONS

ALRC - Agency for Land Relations and Cadastre

CIFOR – Center for International Forestry Research

ENPI-FLEG – European Neighborhood and Partnership Instrument East Countries Forest Law Enforcement and Governance

ES – Ecosystem Services

FRMI – Forest Research and Management Institute

MARDE – Ministry of Agriculture, Regional Development and Environment

MEA – Millennium Ecosystem Assessment

Moldsilva – Agency Moldsilva

NBS – National Bureau of Statistics of the Republic of Moldova

PEN – Poverty Environment Network

SFE – State Forestry Enterprises

SFI – State Forestry Institutions

TAU – Territorial-Administrative Units

TEV – Total Economic Value

ABSTRACT

The concept of ES is present in the Republic of Moldova through already adopted in the forestry practice classification system, which is traditionally applied in the field of forest management. At the international level, the concept has been continuously developed, seeking to bring new information on the benefits provided to society, thus making the link between natural ecosystems and human well-being. The analysis of the current state of research at international level highlighted a comprehensive set of tools for integrating the concept of ES into decision-making process. At the level of the Republic of Moldova, several valuable studies on the identification, description and evaluation of ES were discovered and analyzed, all of them remained without a subsequent applicability. This approach has gained continuity through this research, which represents a bridge between the knowledge collected so far and how to integrate such a knowledge in decision making. The aim of the research was to provide an informational tool to support decision makers in directing their decisions towards a sustainable way to solve the problems that the Republic of Moldova is struggling with in the field of natural resources, both from ecological and social perspective. To this end, a general methodological framework was identified that and also formed the basis of this research. The methodology of it, consisted of the interaction of three dimensions: technical, social, and political, the result of which provided a set of clear recommendations on how to improve the management of the forestry sector in the Republic of Moldova, but also the relationship between community and ES. The technical dimension was approached by conducting research on the theory and applications of the concept of ES, both nationally and internationally. The social dimension was included by conducting the study to assess the forest dependence of rural communities. Also, it showed that the rural communities of the Republic of Moldova do not generate income from forest resources, but have a major dependence on wood resources. Political dimension was included by conducting an institutional analysis that described how the political objectives are met, which in the Republic of Moldova have been identified as aimed at ensuring sustainable forest management. Having as theoretical basis the causal benchmarking model designed based on three levels of sustainable forest management, institutional analysis showed that state forestry institutions have only a moderate performance in achieving sustainability objectives, mainly due to self-financing structures. The conclusions argued that conservation efforts will not be effective as long as people's needs are not met. If they are not met the emergence of various unsustainable, even illegal, practices are favored. Stakeholders, especially the rural population, need to be included in the decision-making process. Solutions must be cross-sectoral and have long-term approaches. A clearer formulation of forest policy objectives is also needed, among with a solid budget support, clearer delimitations between the attributions of the institutions, more efficient forest management structures and a greater focus on social needs and non-state forests.

CHAPTER 1. INTRODUCTION

1.1. Introductory aspects

1.1.1. The ES concept

The interest aroused, both in research and in decision-making, by the ES concept has been and is significant (Liu et al., 2010), especially after the publication of the MEA report (MEA, 2005). According to it, ES are described as a flow of resources or services from the environment that people directly or indirectly benefit from. These services were classified into four categories: provisioning, regulation, cultural - which directly influence people, and support, which come to support other services (Figure 1; MEA, 2005; Drăgoi, 2008).

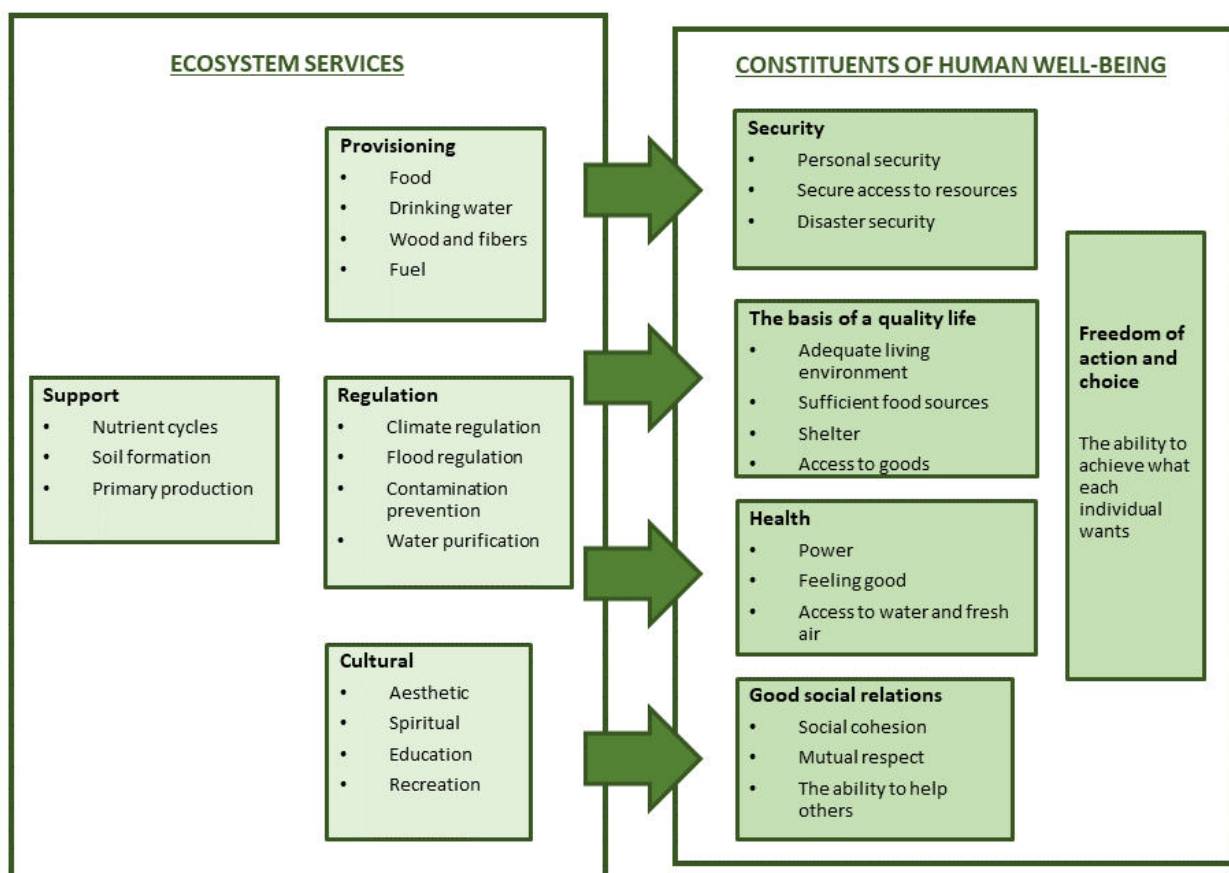


Figure 1. ES and human well-being (Popa and Pache, 2016; based on: MEA, 2005)

In the Republic of Moldova, the use of the ES concept (including TEV assessment) is in the attention of researchers and practitioners in the fields related to natural resource management, the forestry being a pioneer and a leader in this regard. Based on the platform of forest functions, theorized, and traditionally applied in the field of forest management, the ES concept sought to bring new information by taking into account, to a greater extent, the benefits of the forest in the social, economic and cultural field and, especially, by attempting to quantify the value of ES.

1.1.2. Institutional analysis

For many former socialist countries, including former Soviet republics, the forest sector institutional framework has been an important concern (Lazdinis et al., 2009; Abrudan, 2012; Popa et al., 2019),

the last 30 years being a period of prolonged institutional reforms (Lazdinis et al., 2009; Abrudan, 2012; Brukas, 2014; Teder et al., 2015). In many of these countries, significant efforts have been made to change from a hierarchical and highly interventionist system to a system characterized by greater transparency and openness to society, that respects private property (Abrudan, 2012; Bouriaud et al., 2013; Weiss et al., 2019), is more sensitive to the societal needs (Drăgoi et al., 2011; Ulybina, 2014), and more adapted to the requirements of the market economy in general (Scriban et al., 2019; Živojinović et al., 2017). Numerous studies show that the reform of forestry sector institutional framework has not always been a complete success, many of the solutions proving to be too simplistic (Popa et al., 2019) and there is a general concern regarding possible mistakes in the institutional area (Lazdinis et al., 2005; Drăgoi et al., 2011; Nichiforel et al., 2018). There are evidence indicating that the traditional interventionist and paternalist type of institutional approach is still present (Chudy et al., 2016; Nichiforel et al., 2018), underestimating the involvement of stakeholders in the forest management process.

Therefore, it is explainable why research efforts are increasingly focusing the SFI performance in achieving their economic, ecological, and social goals, aiming at formulating strategic options for future sustainable development for the sector (Chudy et al., 2016; Stevanov et al., 2018; Hasnaoui and Krott, 2019). One method of analyzing the institutional framework, that has been successfully replicated in many former socialist countries, is the one proposed by Krott and Stevanov (2008) (Krott and Stevanov, 2008). The method evaluates the performance of SFIs, based on a benchmarking model consisting of three-levels interaction (Krott and Stevanov, 2008). This model considers all levels of sustainable management and is easy to use and adapt Chudy et al., 2016).

Despite the changes that had occurred through the last 30 years, the forestry sector in the Republic of Moldova remains conservative and less receptive to the emerging socio-economic realities (Moldsilva, 2012; Mitchell et al., 2015; Galupa et al., 2018). The state owns 85.7% of the forest (ARFC, 2021), which indicates a very high responsibility of SFIs in the management of the country's forest resource. According to the Forestry Code (CS, 1996), the goal of country's forest sector is to ensure the continuity of ecological and socio-economic functions assigned to forests. However, the forest sector development strategy emphasizes the challenge of continuous forest degradation and insufficient effectiveness in maintaining the ecological balance needed for the sustainable development of society (HP, 2001; Moldsilva, 2012). In these conditions, an institutional reform strategy for the sector was elaborated proposing solutions for strengthening the SFIs in their role of regulation, control, and management of forests (Moldsilva, 2012), but it has not been officially adopted nor implemented with some insignificant exceptions (Lozan and Rotaru, 2015).

1.1.3. Forest dependency analysis

Forests play an important role in the lives of rural populations through the supply of crucial provisioning, regulating, supporting, and cultural services (Bakkegaard et al., 2016). There are multiple reasons why natural resource management policies should consider what forest ecosystems offer to local communities, and how this makes a significant impact on strategy and policy development (Angelsen et al., 2014; Fedele et al., 2021). By meeting needs or providing a potential source of income from the use of forest resources, forest ecosystems can make a significant

contribution to poverty alleviation (Sunderlin et al., 2003; Miller et al., 2021). Specifically, forest management policies should be targeted to meet subsistence needs and encourage those who are able to increase their income through forestry activities (Arnold, 2001) or who directly depend on access to the forest resource for basic needs (Nerfa et al., 2020). However, unsustainable forest practices often tend to work against the interests of the poor (Hill, 2000; Tacconi and Williams, 2020), sometimes resulting in transfers that favor the richest (Arnold, 2001; Andersson et al., 2018). Uncovering where the intention to conserve forests and meet people's increased demand for forest resources are interlinked is another angle of the story (Sunderlin et al., 2003; Harbi et al., 2018), one which could allow rural people and forests to coexist in a win–win relationship (Sunderlin et al., 2005; Cao et al., 2020). Externally controlled conservation initiatives, including the expansion of protected area networks, often give rise to considerable 'human–nature' conflicts as they involve strategies that may change local practices and threaten social outcomes, thus posing risks which may render conservation efforts ineffective (Dawson et al., 2021). The concept of ES (MEA, 2005) is based on the interdependence between natural and human well-being (Rendón et al., 2019; Costanza, 2020), and for this to be true, local people should be the primary stakeholders in designing forest resource management policies while their lives remain connected with forests (Warner, 2000; Armitage et al., 2020). The interaction that takes place between local communities and forest ecosystems requires a thorough analysis that considers all hidden facets (HE et al., 2018), and for the needs of forest-dependent communities to be met in a sustainable way this must be the primary focus of forest management (Warner, 2000; Soe and Yeo-Chang, 2019).

To some extent, all people are dependent on the forest, which combines both historical and modern values defined as human–forest relationships (Arfin-Khan and Saimun, 2020), with some groups being more dependent on this resource from the perspective of meeting basic human needs (Fedele et al., 2021). Forests have significant potential to improve living conditions, especially for rural people (Sunderlin et al., 2003; Razafindratsima et al., 2021). This has also been demonstrated by the PEN project, one of the largest quantitative research projects on forests and rural livelihoods. The project was coordinated by the CIFOR and employed a method that involved quantitative surveys of community members in rural areas regarding their households' wealth and sources of income for families. In addition to providing opportunities for global comparisons, this unique method yielded results that demonstrated two central elements in all the cases investigated: (1) wealthier (higher-income) rural households use higher amounts of forest products (Arnold, 2001; Andersson et al., 2018) and (2) poorer households are more dependent on forest resources through their higher share of total household income (Arnold, 2001; Angelsen et al., 2014). This proves how important forests are for rural incomes and how dependent rural households can be on the resources (sometimes at subsistence level) provided by forest ecosystems, although these resources may differ from one country or region to another. The information included in the PEN project describes the current situation and demonstrates not only the role of forest and environmental resources for rural households, but also how important it is to produce tools that can help design appropriate policies prioritizing forests' contribution toward satisfying people's essential needs as well as ensuring these resources are continuously generated by sustainably managed ecosystems (Bakkegaard, 2014).

Most of the PEN project research has been conducted in poor and developing tropical and subtropical countries located in Latin America, Asia, and Sub-Saharan Africa (Angelsen et al., 2014), where forest management is often poorly carried out or non-existent (Rutishauser and Herold, 2017); for these areas, the role of forest products in the lives of rural households is continuously changing as their standard of living increases. The method designed by CIFOR has also been replicated without significant methodological changes in the EU-funded regional ENPI FLEG II program that involved seven countries (Armenia, Azerbaijan, Belarus, Georgia, Moldova, Ukraine, and Russia). Analysis in the former Soviet space (Bakkegaard, 2014) has shown that income from forest resources has a significant share in the total income of the poor, thus expressing their dependence on the forest, and at the same time, that the richest have higher incomes from the use of forest ecosystems. The majority of communities signal that forest products are becoming less available by pointing towards the continuous decline in provisional services generated by forest ecosystems, with the main drivers of this being overharvesting, illegal logging, and climate change (Bakkegaard, 2014). Similar to PEN studies in tropical and subtropical countries (Angelsen et al., 2014), the study in the ex-soviet space illustrates how important forest resources are to rural households and highlights the main principles that can be used for developing appropriate policies that should consider the needs of rural communities (Bakkegaard, 2014). Increasing total population income and alleviating poverty will not reduce pressure on natural resources; likewise, limiting access to natural resources through exclusively conservationist policies will only jeopardize the living standards of poorer households.

1.2. Aim and objectives of the research

The aim of the paper is focused on providing an informational tool that would support decision makers to direct their decisions towards a sustainable management, thus contributing to solving some social and environmental problems that the Republic of Moldova is struggling with.

The objectives pursued to achieve the proposed goal are:

- presentation of the way in which international research has evolved so far regarding the use of the ES concept in the development and implementation of tools and policies and, on the other hand, the analysis of studies conducted so far in the Republic of Moldova on ES: identification, their description and evaluation;
- identifying the extent to which SFIs in the Republic of Moldova fulfill their responsibilities to implement the objectives of the national forestry policy, but also to identify the causes and processes that influence the performance of SFIs, respectively their position against ES and thus suggest strategic options for future forestry policies;
- inclusion of the social dimension in the study by assessing the dependence of local communities on forest resources and identifying their sensitivity to ES;
- developing recommendations on how to improve the forestry sector and the ES-community relationship to ensure sustainable management.

CHAPTER 2. USE OF THE ES CONCEPT IN DEVELOPING AND IMPLEMENTING NATURAL RESOURCES MANAGEMENT POLICIES

2.1. The development of human society and the ES concept

The publication of the MEA report (MEA, 2005) marked an important moment in the global debate on how to measure economic performance: there are increasingly strong positions supporting that the use of established macroeconomic indicators, such as gross domestic product (GDP), do not adequately capture human and social well-being, nor the relationship with natural systems that provide resources. Strong arguments are presented in support of the need for the adoption of indicators that allow a more integrative measurement of the progress of human society that captures, in addition to economic progress and performance, the sustainability of socio-ecological systems (Schleyer et al., 2015). The diminishing benefits provided by ecosystems are becoming increasingly evident as natural capital is apparently depleted rapidly (Beddoe et al., 2009). But often the importance of natural ecosystems is recognized only after they have been lost (Chambers et al., 2007). The continuous decline of biological biodiversity and the natural quality of ecosystems, as poverty persists, has aroused interest in policies that protect, restore, and improve ES (Posner et al., 2016). In this debate, the ES concept is an important tool used to raise awareness by communicating the value of nature, resilience, and sustainability of socio-ecological systems, having the undeniable advantage of converting integrative information about social-ecological systems into financial and economic language, which can be transposed into different policy areas and integrate different types of knowledge (Schleyer et al., 2015). ES provide an important part of the total contribution to human well-being; therefore, it is necessary to estimate and disseminate the value of natural capital, to substantiate decision-making processes. Otherwise, the current and future well-being of people can suffer drastically (Costanza et al., 1997). The high interest in the concept of ES, both in research and in policy making (Schleyer et al., 2015), is considered an effective bridge between ecological and economic-political approaches (Constanza et al., 2017). The economic evaluation of the ES is meant to progressively enrich the points of view and to demonstrate the need to change certain political directions (Laurans et al., 2013). Thus, the ES concept can make significant contributions to addressing global challenges, including climate change, biodiversity conservation and social welfare (Congreve and Cross, 2019). The integration of natural and economic research is needed to assess the spatial and temporal flow of ES relevant to human well-being, thus demonstrating the role of ecosystems and helping to establish sustainability criteria in order to avoid overexploitation of ecosystems and operationalize these concepts in regulatory frameworks (Maes et al., 2012).

2.2. Premises for integrating the ES concept into the decision-making process

Conceptual and instrumental premises

The analyzes carried out in the literature are mostly in favor of the conclusion that the ES concept provides an appropriate framework and tools of some use for an integrative approach to sustainable ES flow management in the development and implementation of decisions and regulations. Improvements to the ES concept of the classical approach are mainly found in: i) identifying a common language between the scientific and decision-making world, ii) facilitating dialogue between a wider range of stakeholders, including society, and iii) streamlining the decision-making process by

providing complementary information in order to influence decisions to take greater account of environmental issues. However, there are also some negative conceptual and instrumental aspects, especially in consistency in terms of ES assessment.

Social premises

The ES literature expresses the need to transpose sophisticated conceptual knowledge into a common language, to ensure the understanding and involvement of ordinary people. This integration of society into scientific knowledge would bring a greater awareness of ecological processes and the benefits of the concept in improving their well-being. Such an interaction would drive the establishment of policies that are better suited to the needs of people and ecosystems, to improve and ensure the sustainability of the flow of resources and services they provide.

Trade-offs between ES in the decision-making process

ES quantification provides a framework for formulating trade-offs for natural capital. The protector is paid, and decision makers can make comparisons between different possible scenarios. The positive aspects are accentuated and thus the choice of a favorable management measure is facilitated. All aspects of these assessments are influenced, first and foremost, by people's needs. A comparison factor based on the level of people's well-being, negative or positive changes in this regard determines the identification of the most appropriate decisions.

2.3. Tools for integrating the ES concept into the decision-making process

A conceptualization model is the one presented by Pacha (2015) and Posner et al. (2016). In Figure 2, each of the four columns represents a different path that conditions the success of incorporating ES information into decisions.

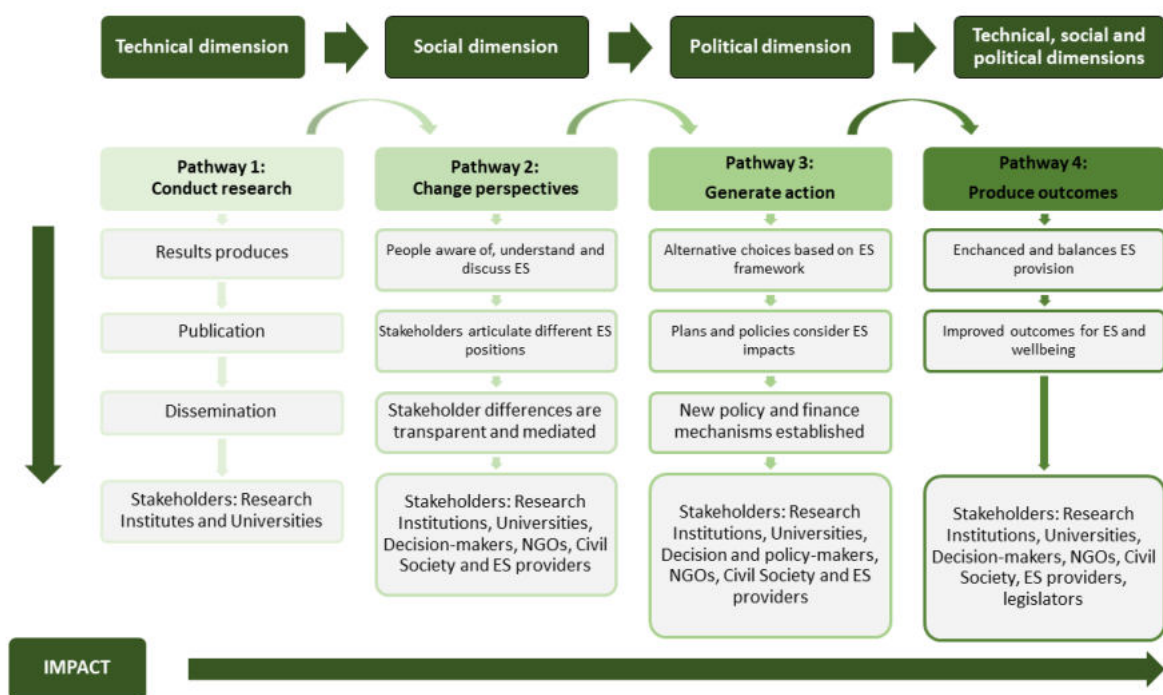


Figure 2. Ways and levels of impact of ES in decision management (Pacha, 2015; Posner et al., 2016)

It is important for decision makers to see ES knowledge as impartial and based on a correct analysis of the different values of stakeholders at all stages of decision making (Posner et al., 2016). Consequently, for the success of ES integration in the decision-making process, in this model, it is necessary to respect three aspects: technical, social, and political. From a technical point of view, data and technical skills are needed to create models and obtain information on the situation and distribution of ES. The social dimension is developed in the second way, where local participation is an essential condition for achieving major community changes. The political factor is developed in the third and fourth way, during which specific policies are developed to maintain and increase the supply of ES and ensure human well-being (Pacha, 2015).

2.4. Conclusions

As a policy approach, the ES framework serves as a conceptualization of the link between ecological integrity and human well-being, integrating knowledge, economic and social values with environmental ones. The concept has all the premises to be used as a tool for communication of the importance of environmental protection for policy makers, users of natural and public resources (Hysing and Lidskog, 2018).

There are many methodological models designed to guide the transition from understanding the functionality and structure of ecosystems to developing sustainable management policies through the communication of the benefits of ES to human society.

The transfer of the ES concept in sustainable policies is a very complex and long-term approach, and can be influenced by many factors, from the complexity of ecosystem processes and structures to uncertainties regarding ES modeling, assessment and management (Constanza et al., 2017), and up to to certain political priorities of decision makers. It is important to constantly assess the impacts on existing ecosystems and create new systems through stakeholder participation, through experiments, to quantify performance and learn how to manage these complex systems (Costanza et al., 2017) more effectively. The legitimacy of scientific knowledge has a great impact, counting more than their credibility, being the responsibility of researchers to engage directly with stakeholders or in collaboration with decision makers (Posner et al., 2016). Many of these problems, uncertainties and responsibilities can be overcome by knowing and mediating as wisely as possible the expectations of ES beneficiaries and society as a whole. This can be achieved by constantly measuring perceptions and expectations, but also by disseminating campaigns of successes and failures in ES management, both to the public and to the direct beneficiaries of ES and decision-makers. Only in this way can the ES concept be an effective link between science and politics, making trade-offs more transparent. This concept can be a beneficial addition for policy-making institutions and a framework for integrating science into policies (Costanza et al., 2017). Policy decisions must be based on reliable estimates of current and assumed trends in the provision of ES and their economic values, including the spatial distribution of resources that provide ES (Maes et al., 2012). Governance of socio-ecological systems, for a sustainable supply and distribution of ES, requires adapted institutions and governance strategies that take due account of these complex, dynamic and multi-level interrelationships (Mann et al., 2015).

CHAPTER 3. FORESTRY SECTOR IN THE REPUBLIC OF MOLDOVA

3.1. Forestry sector snapshot

According to the latest publicly available data, provided by the ALRC of the Republic of Moldova, on 01.01.2021 (ARFC, 2021) the area of the national forest fund is 449.8 thousand hectares (13.3% of the country's territory) of which 362.8 thousand hectares are state-owned, 84.3 thousand hectares are publicly owned by TAUs and 2.7 thousand hectares are privately owned (Table 1). The surface of the lands covered with forests is 370.7 thousand hectares, of which 317.7 thousand hectares are owned by the state, 50.5 thousand hectares are owned by TAUs and 2.5 thousand hectares by private owners. At the same time, the Republic of Moldova also has 50.8 thousand hectares of forest vegetation outside the forest fund, of which 30.3 thousand hectares are represented by forest protection curtains and 20.5 thousand hectares of other types of forest vegetation. The share of forest, of about 11.0% (ARFC, 2021) of the country's surface, is still considered very low (Talmaci and Miron, 2016); without an expansion of forest territories, the rural area will bear the consequences of natural hazards and anthropogenic influence, especially since, in some areas of the republic, aridification is intensifying and signs of desertification have appeared (Talmaci and Miron, 2016). In fact, the forest fund of the Republic of Moldova is also strongly fragmented (Figure 3). Uneven spread and fragmentation of forest lands negatively influence the fulfilment of their economic and protective functions (Moldsilva, 2016). Hardwood species predominate (98%), and oak forests (44%) are the most representative forest ecosystems contributing over 80% to the country's biodiversity (TUB, 2015; Moldsilva, 2016).

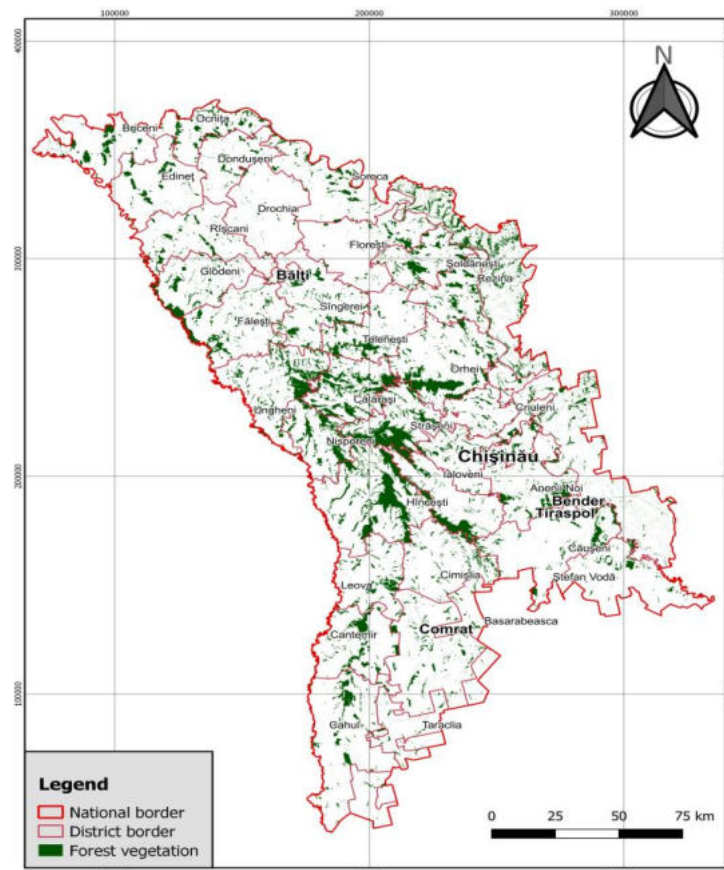


Figure 3. Forest vegetation in the Republic of Moldova

Table 1. The structure of the forest fund according to ALRC on 01.01.2021

Categories of holders	Total area/share, thousand hectares/%	Area covered with forests/share, thousand hectares/%
State public property forest fund	362.8/80.7	317.7/85.7
Public property forest fund of TAU	84.3/18.7	50.5/13.6
Privately owned forest fund	2.7/0.6	2.5/0.7
Total	449.8/100	370.7/100

The forest resources of the Republic of Moldova are characterized by low values of indicators, for each inhabitant it's 11.3 m³/year of wood and 0.16 m³/year of harvested wood (Galupa et al., 2018). However, most of Moldsilva's forestry revenues come from the recovery of timber (Moldsilva, 2016; Galupa et al., 2018), the agency being based on a self-financing mechanism introduced in 1998, considered to have a high pressure on existing forests (Lozan, 2021; Spitoc et al., 2021). According to official reports, the volume of timber harvested from the forest fund managed by Moldsilva is close to the possibility established by the forest managements plans. The low income resulting from the use of non-timber products is, on the one hand, influenced by the fact that most of the areas that have been cultivated with different fruit forest species are degraded or transferred to another category of land use (Novac, 2018), on the other hand, the absence of specialized units for the collection and processing of raw materials (Galupa and Rotaru, 2016), but also the insufficient investments and low interest in promoting these resources (Talpă et al., 2021).

3.2. Forest management

The institutional framework of the forestry sector (Figure 4) includes: MARDE, Environmental Agency, Ecological State Inspectorate, Moldsilva Agency, SFE, and TAUs owning forests. MARDE is responsible for developing policies and regulations (HG, 2017). Under its subordination there are: i) Moldsilva, which is empowered to ensure the implementation of state policy in the fields of forestry and biodiversity conservation for all forests (HG, 2010); ii) Environmental Agency, in charge with environmental protection policy enforcement (HG, 2018a); iii) Ecological State Inspectorate, controlling body in the field of environment (HG, 2018b). TAUs have some legal obligations regarding the management of their owned forests (CS, 1996) but there is no clear separation between their attributions and the mandate of Moldsilva over the communal forests (Popa et al., 2016).

The management function of the state is exercised by 25 legally independent SFEs, territorial entities functioning as regular state owned enterprises and managing the state-owned forests, with minimum budget allocations (Lozan and Rotaru, 2015; Talpă et al., 2019). Communal forests are managed unequal, just some of them through municipal enterprises specialized in providing forest management services, among other public services (Prosii and Talmaci, 2018). Moldsilva is a self-

financed state agency, in charge, among other prerogatives, with SFE coordination, policy enforcement as well as extension services for other forest owners. Moldsilva's mandate includes significant involvement in policy elaboration (HG, 2010), this is considered as an overlapping between the regulation and management functions of the state. Moldsilva can be considered as an authority institution, rather than a management institution.

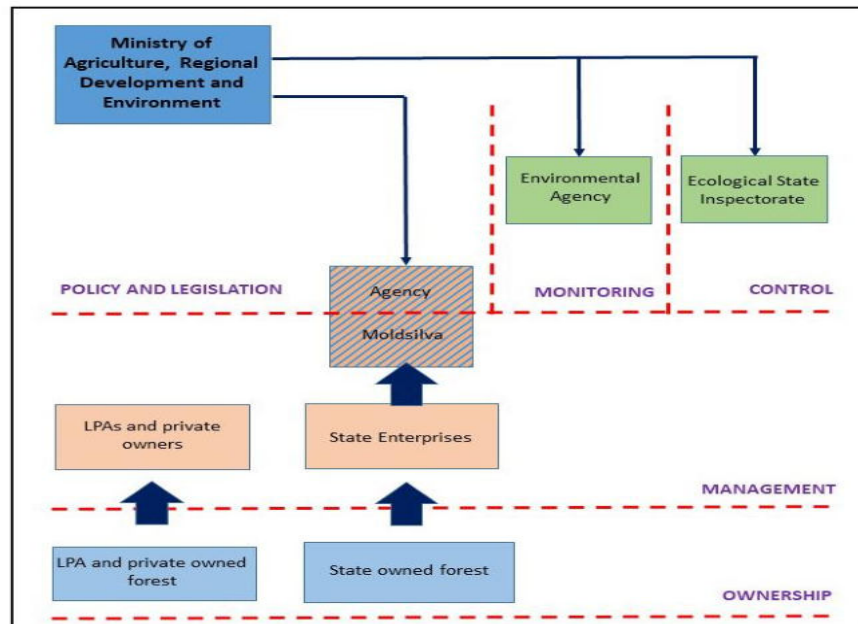


Figure 4. Institutional framework of the forestry sector in the Republic of Moldova

The state-owned forest fund is managed by Moldsilva through a network of forestry enterprises that covers the whole country. The managed surface of the forest fund has forest management plans, developed according to a normative framework based on the principles of sustainable management (Moldsilva, 2016). Only a small part of the non-state forest fund has forest management plans or management structures (Prosi and Talmaci, 2018). Most of the lands with forest vegetation outside the forest fund are not managed. Management is done with violations of forest technologies and compliance with forest ecological requirements (Moldsilva, 2016). The forestry legislative framework in the Republic of Moldova is not so imperfect compared to how it is perceived (Lozan and Rotaru, 2015; Mitchell et al., 2015), but the current state and prospects for forest fund development raise many questions regarding how it is implemented (Budeanschi et al., 2013).

3.3. Application of the ES concept in the forestry sector of the Republic of Moldova

3.3.1. The origin of the adoption of the ES concept in the Republic of Moldova

The current situation of the forestry sector in the Republic of Moldova justifies the current initiatives on institutional and administrative reforms of the sector. In the Republic of Moldova, political and professional institutions show significant resistance to change. Even if in the beginning the decision-makers in forestry were in favor of the reforms, the political evolutions influenced the implementation of the decisions, being realized only insignificant steps (Popa et al., 2016). A negative and present factor lately is the excessive politicization of the sector to the detriment of professional quality (Lozan and Rotaru, 2015). The analysis of the programmatic documents elaborated over the

last 10 years shows that, initially, the documents aimed at the development of the forestry sector in the Republic of Moldova (HP, 2001; Moldsilva, 2012) did not explicitly consider the ES concept. Since 2013, on the elaboration of a new edition of the biodiversity conservation strategy (MM, 2013), the ES concept has found its place more and more clearly in the programmatic documents, due to the awareness that the opportunity created by the ES concept can provide the information needed to guide the reform process (Popa and Borz, 2014). The adoption in an increasing number of studies of the ES concept has been based on the classification system already adopted in forestry practice in the Republic of Moldova.

3.3.2. Identification and description of ES

ESs provided by forest ecosystems in the Republic of Moldova (Table 2) were identified mainly based on the collection, synthesis and interpretation of previously existing data sources, being collected general primary data using the method "ground-truthing", which involves verification and completing records of existing statistics (Popa, 2013; TUB, 2015). Key ecosystems were identified through a qualitative assessment, and qualitative data on ESs to be assessed were also collected through meetings with local consultants and key stakeholders - MARDE, Moldsilva, Moldova State University, FRMI, Institute of Ecology and Geography, National Botanical Garden (Institute) "Alexandru Ciubotaru", forestry, and forestry-hunting enterprises (TUB, 2015). Other studies (Țurcanu and Platon, 2014) did not undertake a qualitative identification or analysis but took over the four categories that contribute to human well-being, according to the MEA report, and evaluated them as such.

Table 2. Types of ES provided by forest ecosystems identified in national ES studies

Type of ES	TUB, 2015	Țurcanu and Platon, 2014
Provisioning services	- Food	- Forest fruits
	- Wood	- Lease of forest fund land for recreational purposes and hunting management
	- Water supply	- Technological wood
	- Non-wood forest products	- Firewood
	- Energy sources	- Biochemistry, natural medicine, and pharmaceuticals
		- Other forestry uses
		- Other wood production
Regulation services	- Greenhouse gas regulation	- Adjusting the greenhouse gas balance in the atmosphere, carbon dioxide retention
	- Microclimate stabilization	- Water regulation, water protection
	- Water regulation	- Biological control
	- Soil erosion regulation	
	- Nutrient retention	

Type of ES	TUB, 2015	Țurcanu and Platon, 2014
Cultural services	<ul style="list-style-type: none"> - Spiritual, religious, and cultural heritage - Education - Recreation and ecotourism - Landscape - Non-use of biodiversity 	<ul style="list-style-type: none"> - Knowledge systems, educational values, inspiration, aesthetic values - Spiritual and religious values - Recreation and ecotourism - Improving the health of society - Hunting products and services
Support services	-	<ul style="list-style-type: none"> - Field and soil protection services, soil formation and conservation, increasing agricultural productivity - Increasing agricultural productivity by creating new forest protection curtains - Enrichment of airspace with oxygen

3.3.3. Assessment of ES

A first estimate using the ES TEV instrument was made by FRMI Chisinau, on a total area of 335.3 thousand hectares (Budeanschi et al., 2013). FRMI estimated the value of ES at about 53.7 million USD.

Table 3. Results of ES provided by forest ecosystems assessment in national ES studies

Type of ES	Reference value 2012, million USD (Țurcanu and Platon, 2014)	Reference value 2014, million USD (TUB, 2015)
Provisioning services	18.45	64.0
Regulation services	44.2	2.7
Cultural services	20.96	2.2
Support services	33.5	-
Total	117.11	68.9

In two other analyzed studies a considerable difference of the ES value is observed (Table 3). Although the reference value for 2012 was assessed for a forest fund area of 336,541.3 hectares managed by Moldsilva, and the reference value for 2014 was assessed at national level, there is a large difference of cost assessments. This difference is related, first of all, to the different set of ESs, as well as to the predominant use in these evaluations of the estimation of the direct costs of use and only partially of the indirect costs (Cazanțeva et al., 2016).

3.3.4. Implications of the assessment of ES in the financing of protection measures

Currently, there is little relevant information on the policy on the economic value of ES in the Republic of Moldova, and biodiversity conservation is not a priority in budgetary and economic policy. Public

and corporate decision-makers, who face increasing pressure on funding, tend to allocate fewer financial resources to protected areas and biodiversity conservation in general, compared to other sectors, which are perceived to be more productive in terms of development.

3.3.5. Conclusions

The results of the literature review demonstrated that the ES concept provides a consistent framework that integrates a wide range of environmental knowledge and can formulate solutions to the problems of sustainable natural resource management. It can interconnect society with science, ensuring a common language and facilitating the integration of stakeholders in influencing decisions and policies. We can say that this concept also has an interdisciplinary role perspective, which unites the interests of different fields, researchers, and stakeholders to identify the most appropriate scenario for all actors that benefit or provide ES, but also to restore/improve the condition of ecosystems.

Although there are strong arguments for the benefits of the ES concept in ensuring the sustainability of the flow of resources and services, and improving the well-being of people, the integration of this framework into the decision-making process has not been achieved in line with expectations. However, in support of this approach, numerous applications for transposing the concept into decision-making tools have been developed. These tools demonstrate the future guidelines and modalities of applicability of this framework. Demonstrating the good ability of the concept to be used for communication and to strengthen the interrelationships between society and nature.

Despite the novelty of the ES concept, there are important concerns in the Republic of Moldova regarding its application in the forestry field. These concerns are integrated into the development of programmatic documents specific to the forestry sector or biodiversity conservation. Generally using established methods for identifying and quantifying ES (but different from study to study), the analyzed works use to a lesser extent direct research and to a greater extent interpolations, interpretations and synthesizations of publicly available data. Therefore, ES values, as they have been quantified so far, are within significant margins, although all studies show consistent values. Also, the development of alternative scenarios on the evolution of the value of ES shows important benefits, in the medium and long term, that could result on all levels through the sustainable management of the forest resource.

Although many of the analyzed studies have been used to develop proposals for strategies to improve forest fund management, many of these policy documents are blocked in their implementation, so that the identification and quantification of ES remains a rather theoretical approach. However, the analyzed studies represent a first attempt to evaluate these services in the Republic of Moldova, a starting point for further research aimed at more accurately determining the influence of ES on the economic, social, and cultural field and a more accurate analysis of the impact determined of the steps to reform the sector, so as to allow a better scientific substantiation.

CHAPTER 4. METHODOLOGY

4.1. Institutional analysis

4.1.1. 3L Benchmarking model as theoretical basis for institutional analysis

The 3L causative model was designed by Krott and Stevanov in 2008 aiming at developing a tool for evaluating SFIs performance in a comprehensive, yet science-based and easy to apply way (Krott and Stevanov, 2008). In the method, SFIs are divided into two main categories: (1) management institutions with mandates related to direct management, i.e., management planning, goal setting, products and services provision, regeneration, guarding, etc., and (2) authority institutions with regulatory, policy making and enforcement tasks (Stevanov and Krott, 2013).

The 3L model (Figure 5) is based on designing evaluation criteria by interpreting the policy goals through a more precise theoretical framework. The core of the model is the interaction between the 3 layers (3L): the layer of public policy goals – how the principles of sustainable forest management are mirrored in the country forestry goals – the layer of theoretical frameworks and the layer of empirical measurements. The relevance level includes policy goals and programs formulated by the state for a sustainable forest management while the theoretical layer combines the recognized economic, political, and ecological theories. The empirical layer includes perceptions over the implementation of elements from the other two layers. The novelty of the model lies with the fact that vague and generalist language of the policy documents and programs (included in the layer of public policy goals) is translated into more precise terms by considering the natural science, political, public economics, and business management theories (included in the theoretical layer). As a result, clear and science-based criteria (Krott and Stevanov, 2008) are formulated. The empirical level is evaluated against these criteria and all identified differences indicate on institutional performance.

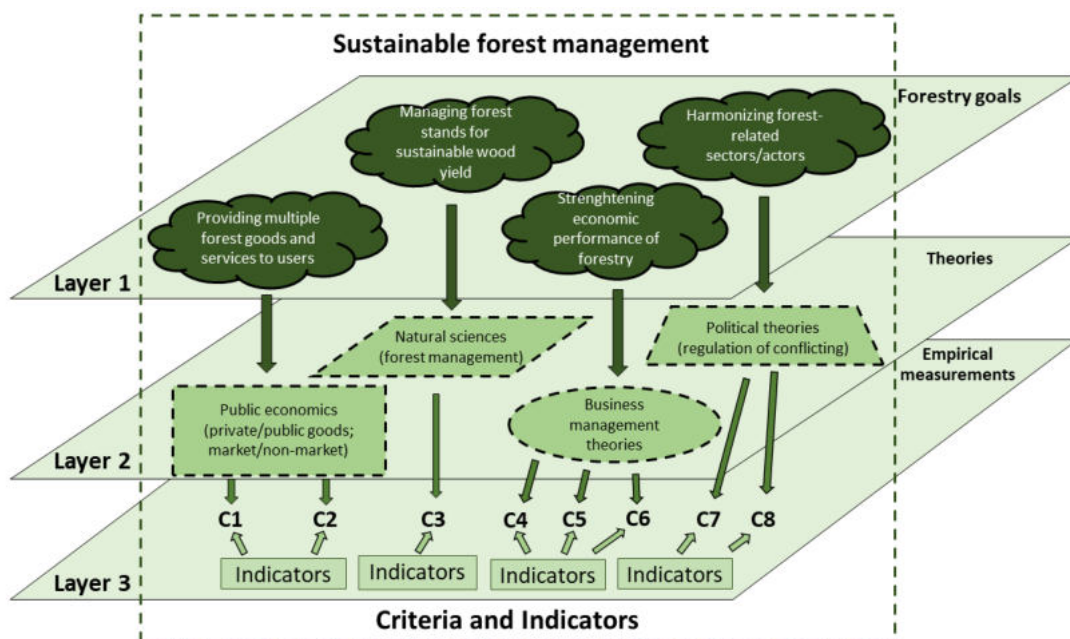


Figure 5. The 3L Model (three-layer model): designing criteria (C) and indicators (I) for comprehensive, science-based evaluation of SFI (Krott and Stevanov, 2008; Chudy et al., 2016; da Motta Bustamante et al., 2018)

Applying this model in the Republic of Moldova involved identifying criteria from the theoretical framework of the method followed by empirical measurements of different documentary sources and forest sector stakeholders' perception over the performances of SFIs relative to the identified criteria.

4.1.2. Collection and analysis of empirical data

Both primary and secondary sources were used for data collection. Primary data were collected through participatory observations and semi-structured face-to-face interviews. Participant observation was conducted during the period of research through attending numerous meetings with sector representatives. Participatory observation is recommended by the methodological frame (3L model), being useful especially for collecting empirical evidence that otherwise can remain inaccessible (Chudy et al., 2016; da Motta Bustamante et al., 2018).

Table 4. Criteria and indicators used to evaluate state forest institutions performance (Based on Stevanov and Krott, 2013)

Criterion	Indicators	
	Management institutions	Authority institutions
C1 Orientation toward demand on existing private goods	Market revenue; Marketing competence	Freedom for harvesting; Quality of information about markets
C2 Orientation towards public and merit-good demand	Plans for production/provision of public/merit goods; Financial inflow for public/merit good production	Restrictions on forest use; Compliance control
C3 Ecological sustainable management ecologică	Obligation of sustaining forest stands; Forest management plans	Legislative framework on sustainable forest management; Forest management
C4 Production efficiency	Technical productivity of work; Managerial accounting	Technical productivity of work
C5 Profits from forests	Annual operating profit	Profitability
C6 Orientation toward new private goods	Professional market information; Investments in innovative products; External partners	Encouraging the marketing of innovative services/products
C7 Speaker for forestry	Trustful cooperation with wood-based actors, aspiration and acceptance of speaker's role	
C8 Mediator of all interests in forests	Trustful cooperation with actors from different sectors but interested in forest sector, aspiration and acceptance of mediator's role	

For preparing semi-structured interviews, support questions were formulated for all indicators recommended by the 3L model (20 indicators for management institutions and 17 indicators for authority institutions), these indicators being designed for a European-wide research (Chudy et al., 2016). Using the support questions, several test face-to-face interviews were applied in the summer of 2019 in order to assess the validity and the applicability of the indicators (Mălai et al., 2019). As a result of this preliminary test, a number of 18 indicators were selected for management institutions and 15 indicators for authority institutions (Table 4).

The interviews were held in the offices of the respondents, in Chisinau, the capital city, and in some other locations, at the regional SFEs headquarters, in Romanian, the official language of Moldova, between May and September 2020. Experts from the following institutions were interviewed: Moldsilva, FRMI, SFEs, environmental Non-Governmental Organizations, Moldovan State University, State Agrarian University of Moldova, Ecological State Inspectorate, MARDE. Anonymity and privacy were guaranteed for all interviewed persons, allowing them to express their perception freely, without other interference, given that the sector is described as highly politicized (Lozan and Rotaru, 2015).

Secondary empirical evidence analysis started with collecting and assessing the regulatory framework that is forming the basis of the forest sector policy, activity reports of the targeted institution, technical reports, and various scientific papers.

After the above described analysis, the information from empirical sources helped to derive conclusions regarding the performance of the targeted SFIs. Indicators pending to each criterion were combined aiming to reach a level of criteria performance evaluated on a scale including: (0) for no performance, (1) for weak, (2) for moderate and (3) for strong performance.

4.2. Forest dependency assessment

4.2.1. Study area

To conduct comparative assessments, in this study, we considered the same three communities subject to the 2014 survey (Popa et al., 2014) that were selected to best reflect the acuteness and sensitivity of forest dependency, also including the traditional occupations of the local people (Figure 6): 1. Alexandru cel Bun village, which is part of the Volovița commune (a collection of two villages) in the Soroca district, also part of the Nistru river basin and of an Emerald site in the Northern region (a forest-steppe landscape type); 2. Ciorești village, which is part of the Ciorești commune (a collection of two villages) in the Nisporeni district (central region or central hilly plateau, part of the most forested area in the country); 3. Borceag village, a locality in the Cahul district of the Southern region (part of a steppe landscape with scattered forest vegetation).

The selection of these localities was based on eco-geographical representativeness (Popa et al., 2014) and according to the three distinct regions of the country - North, Centre, and South. The proximity to forests as a criterion affecting accessibility for an individual or community to be forest dependent was taken into consideration to better understand the relationships on an occupied (inhabited) versus unoccupied forest area (Popa et al., 2014).

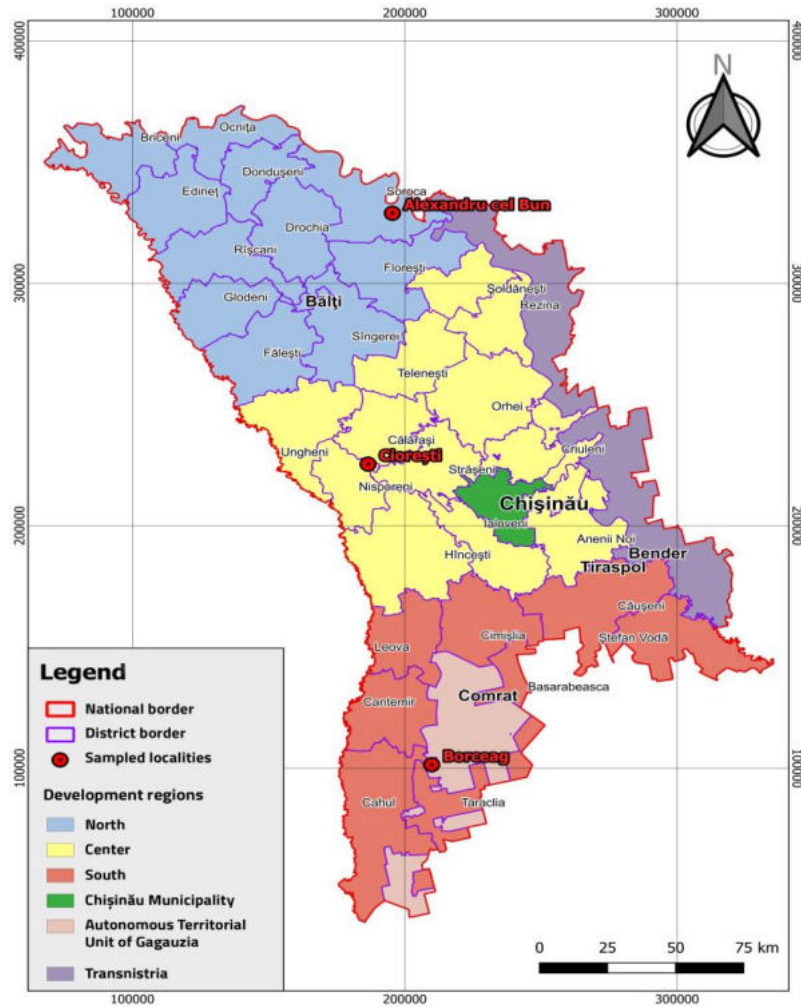


Figure 6. Development regions in the Republic of Moldova and the geographical location of the three sampled localities

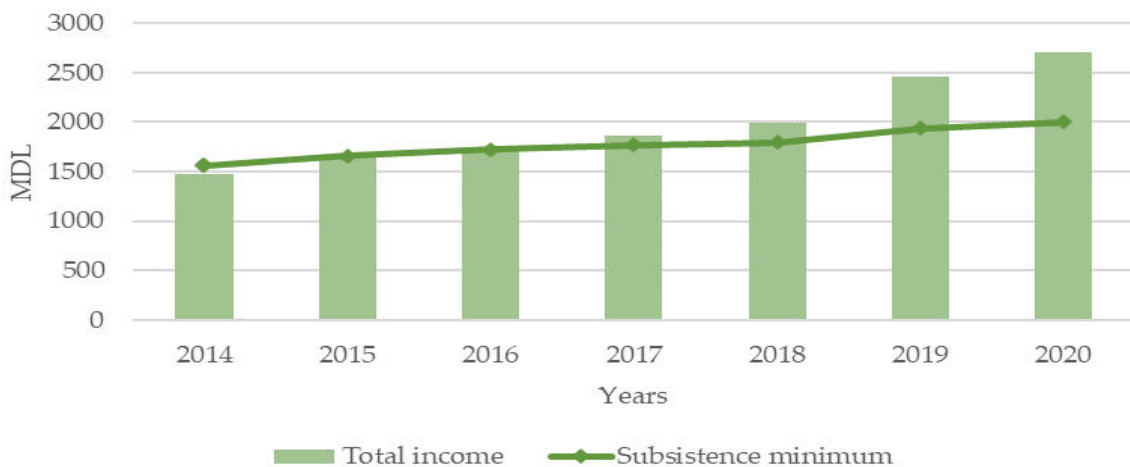


Figure 7. The monthly average value of the total income and the subsistence minimum per person in the rural area of the Republic of Moldova (BNS, 2021)

In terms of socio-economic development and living standards in rural Moldova, a positive aspect is the downward trend in the absolute poverty rate, from 39.5% in 2014 to 35.3% in 2020 (BNS, 2021).

The total average monthly disposable income per person increased from 1,477.2 MDL in 2014 (Figure 7), which did not cover the subsistence minimum, to 2,702.3 MDL in 2020, which exceeds this minimum by 699.5 MDL (BNS, 2021). Of the total disposable income of the rural population, wages have the largest share, reaching 40.5% in 2020, compared to only 30.6% in 2014 (BNS, 2021).

4.2.2. Data collection, processing and analysis

People's dependence on forests is directly linked to household subsistence needs, primarily livelihood-oriented strategies such as providing firewood, timber, NTFPs, jobs, and ES (Arfin-Khan and Saimun, 2020). In Moldova, with limited forest areas but of great traditional significance, all forest ecosystems provide a range of benefits to local communities, and their values significantly exceed official figures of what the actual provisions forests display (Popa, 2018). To assess this dependence on the forest in the three selected localities, a standard quantitative analysis questionnaire was developed and used for assessing the income of each individual household surveyed (Table 5).

Table 5. Sections and content of the household questionnaire (CIFOR, 2008)

Section	Title	Content
1A	Basic information on household members	Relationship to head of household, gender, age in years, years of education, main and secondary occupation of members ≥ 16 years
1B	Identification of the main respondent	Which household member was interviewed
2A	Fixed assets (land)	Area of land controlled or used by the household
2B	Other household fixed assets	Other fixed assets of the household, their quantity and age
3	Forest resource base and environmental services	Distance from the forest, planting of forest trees on own farmland and purpose, perception of ES (respondents were asked to give a score from 1 to 3)
4A	Forest and environmental income	Quantities of forest and environmental products
4B	Firewood consumption	Quantity of firewood consumed
5A	Income from agriculture	Quantities of agricultural products
5B	Costs in farming	Costs of agricultural production
6A	Livestock and their income	Keeping, consumption, and sale of livestock
6B	Income from animal products	Quantities of products of animal origin
6C	Costs in animal husbandry	Quantities and value of inputs used in livestock production
7	Income from salaries	Total income from wages and salaries for each household member, including seasonal work
8	Business income	Total income from own business
9	Other income	Amount received during the last year for each source of income

Table 6. Sections and content of the additional questionnaire for representative persons (CIFOR, 2008)

Section	Title	Content
1	Most important product	For each product category, respondents were asked: the most important products for the livelihood of the rural community, changes in availability and their causes, suggestions for actions to increase their availability (respondents were asked to give a score from 1 to 3)
2	Seasonal calendar	The months in which the most important forest or environmental products are harvested, and which are the most important seasons for agricultural activities
3	Infrastructure and markets	Number of roads, access to electricity, gas and water, distance of villages from markets, other benefits received related to forest services
4	Wages	Regular wages for men/women in good times/hard times
5	Prices	Local prices for products in the village

Households where interviews occurred were selected using the three-household sampling design. After interviewing the respondent from the first household located at the entrance to the locality, the third household in order was to be approached. If members of the household refused to respond, the one in the immediate vicinity was approached. Members of 50 households were interviewed in each village, resulting in a total of 150 interviews. Besides the standard questionnaire, for 10 representative persons in each village who occupy higher social or technical positions, questionnaire 2 was used (Table 6) to collect qualitative data on the most important livelihood products as well as more information on infrastructure, markets, and prices of products.

All data collected from offered questionnaires were then entered into an MS Office EXCEL database. With the help of questionnaire 2, based on the answers of the total of 30 respondents (i.e., information concerning the prices of agricultural, livestock, and forestry products present in each village), a table with average reference prices for each type of products was produced. Using this table, data on quantities of products in all categories were converted into monetary value, and by subtracting the costs for their production (reported by the respondents), a value of income per source of income was generated. To identify the average monthly income per person, the total income earned per village was divided by the number of adults in each village, excluding those still in education and not contributing any income to their households.

The 2014 research (Popa et al., 2014) included both income and expenditure incurred by procuring forest products in only one category, and that is the income for household members. In the present study, the dependence of households on the forest was analyzed by considering both collected and procured products. On the one hand, some villagers receive forest products as social aid or collect them directly from the forest (meaning they are allowed to have free access to the resource), which they value themselves or consume in their own households (*collected products*). On the other hand, firewood as a primary energy source is the main demanded forest product villagers procure against a fee proscribed in the technical norms or other economic documentation of the state forest entities subordinated to Moldsilva (*procured products*).

CHAPTER 5. INSTITUTIONAL ANALYSIS

5.1. Institutional analysis results

5.1.1. Forest policy objectives

The qualitative analysis of the programmatic documents referring to forests and environmental policy revealed a clear orientation towards sustainable forest management, as an overall goal. The forest protective functions increase/continuity are at the core of the 1996 Forest Code, together with the goal of increasing productivity (CS, 1996). According to the Forest Code, all the state forests in Moldova are awarded primarily with protective functions, the production function being considered as secondary. The emphasis of policies on protection functions is also reflected in the concern caused by the continuous degradation of forest quality, the sector's development strategy setting targets for increasing forest area and recovery measures for them (HP, 2001). The existing legal framework for sustainable management does not really include the purpose of relating timber production to domestic timber consumption, estimated to be higher than supply (Popa, 2013). This may indicate possible unsustainable operations, often camouflaged in an imperfect legal framework.

5.1.2. Forest management institutions – SFE

The analysis of SFE performance considers all 8 criteria recommended by the adopted methodology (Krott and Stevanov, 2008) and 18 adapted indicators. The results are illustrated in the spider net chart in Figure 8.

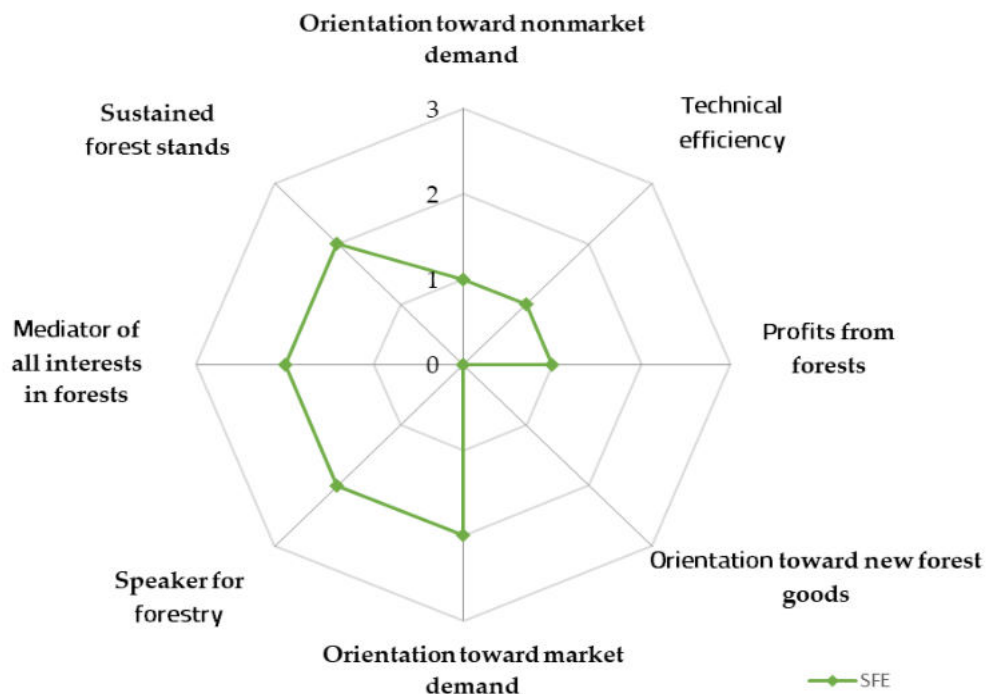


Figure 8. Performance of forest institutions with management tasks in Republic of Moldova

5.1.3. Institutions with authority tasks

Forest sector authority function in Republic of Moldova is split between MARDE and Moldsilva. MARDE mandate includes the permanent assessment of the sector status, elaboration of public

policy, sector specific regulations and state interventions as well as monitoring the enforcement efforts. Moldsilva has also numerous institutional tasks in the authority area: 1) it is empowered to determine the priorities of the sector, to elaborate proposals for strategic planning and policy elaboration as well as organizing and coordinating the sectoral policy enforcement; 2) it should develop and maintain the informational data base including relevant sectorial data; 3) it is the extension services provider to other forest owners (mainly TAUs); 4) it is the only entity that elaborates forest management plans for all forest owners; 5) it exercise the prerogatives regarding the diversification of forest products and services marketing strategies (HG, 2010; HG, 2017). Although Moldsilva is a self-financing agency, with strong institutional independence, it is still subordinated to MARDE, therefore, the analysis of authority tasks SFI performance includes both MARDE and Moldsilva. The analysis considers all 8 criteria recommended by the adopted methodology (Krott and Stevanov, 2008) and 15 adapted indicators (Table 4). The results are illustrated in a spider net chat (Figure 9).

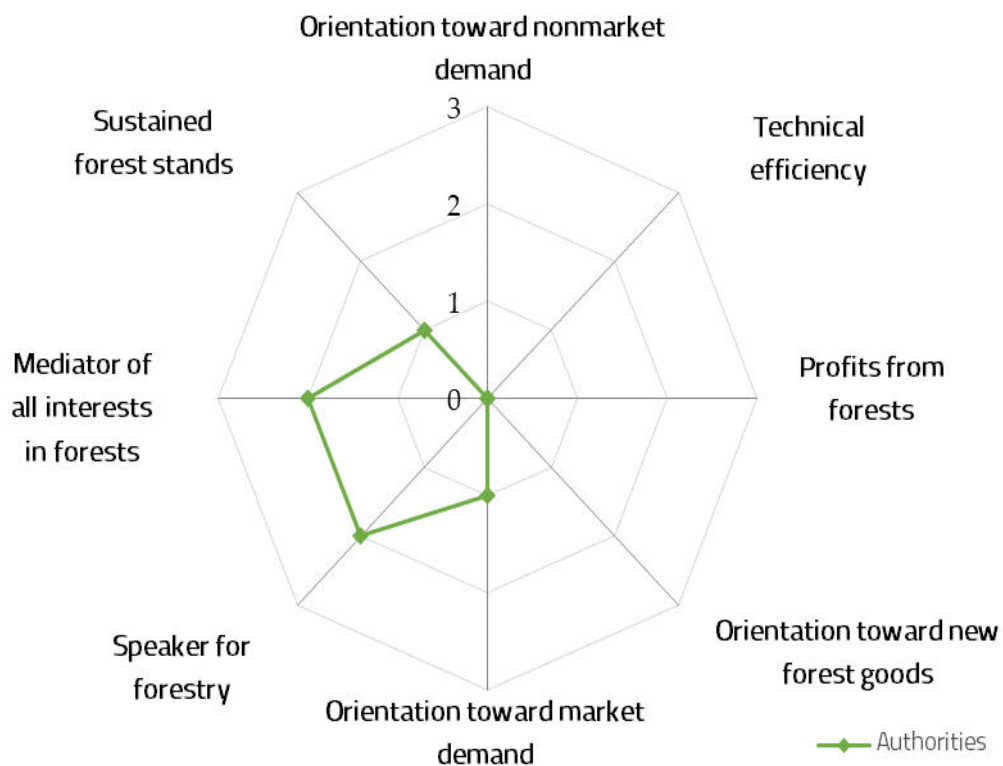


Figure 9. Performance of forest institutions with authority tasks in Republic of Moldova

5.2. Discussion

The practical application of the criteria and indicators designed by Krott and Stevanov (2008) in other countries (Stevanov and Krott, 2013; Chudy et al., 2016; de Motta Bustamante et al., 2018; Hapa, 2019) was very helpful in direct replication of the model in Republic of Moldova. With very few necessary adaptations in terms of number of indicators (due to the specific conditions in Moldova that made some indicators inapplicable), the model was easy to apply in Moldova's conditions. By using the 3L Model, this study produced results that allow easy comparisons with evaluations done in other countries, thus proving the fact that the model is serving the original benchmarking scope. This

quality comes also from the fact that some indicators (e.g. profitability, technical productivity of work) are judged in comparison with other countries for which data were available also due to the previous implementation of the Model (Stevanov and Krott, 2013; Chudy et al., 2016). The main limitation of the method is the possible lack of data (Chudy et al., 2016) for secondary empirical evidence. As in other studies (Chudy et al., 2016; Hapa, 2019), this research encountered some difficulties in the case of non-state forests, although there were informational limitations for state forests as well. We addressed these shortcomings by paying more attention to the interviews and thus supplementing with more accurate information collected from experts, in order to obtain a more reliable picture of the forestry sector in Moldova.

The results reveal that Republic of Moldova is struggling with numerous issues that seems to be characteristic to many former communist countries, but also with some that are country specific. The management of non-state forests in Republic of Moldova is severely regulated by the state, who solely decides over the management tasks and procedures. Other 3L model based studies found the same situation in many East and Central European countries (Stevanov and Krott, 2013; Chudy et al., 2016; Hapa, 2019). SFIs in Moldova consider private forest management as marginal and there are very intense state interventions due to a lack of trust in non-state owners' ability to meet the prescriptive legal technical requirements. The same general conclusion is drawn by other studies done in eastern and central European countries (Bouriaud et al., 2013; Brukas, 2014), or by comparing countries at European level (Nichiforel et al., 2018). Nevertheless, in the Moldovan conditions, severe budgetary constraints of TAUs (the main non-state owners in Moldova) and the state affects the effectiveness of the very prescriptive regulations. Therefore, the sustainable management goals for non-state forests are often not met. By having Moldosilva in coordinating position for all SFEs, the central authorities are deeply involved in state forest management, with clear overlapping between regulation and management functions, thus affecting the competitiveness of non-state forest management structures. This result is also confirming an East European pattern (Chudy et al., 2016; Hapa, 2019).

Authority tasks institutions in Moldova have lower performance evaluation than the state management structures, this being another aspect that can be seen as characteristic for post-communistic forest sectors as it can be seen in Serbia and Croatia (Stevanov and Krott, 2013) or Poland (Chudy et al., 2016). As proved in other studies too (Chudy et al., 2016), present study revealed that state forest management structures in Republic of Moldova have a high inertia in marketing approaches, almost ignoring the innovation opportunities in forest products and services, partially due to their monopolistic position. There are also some specific features of SFIs in Moldova, derived, at least partially, from the biophysical conditions of the forests: they are facing difficulties in completely fulfilling the sustainability goals, even for state forests, due to an unbalanced ratio between wood demand and supply, being trapped in a situation in which they can't really fulfill the demand without affecting the sustainability goals. Also, the Moldovan SFI efficiency performance, in terms of profitability and productivity, are among the lowest when compared with other studied countries.

5.3. Conclusions

This The 3L causative benchmarking model designed by Krott and Stevanov (2008) was successfully applied in Republic of Moldova, serving the purpose of assessing the performance of SFIs with management or authority tasks. The general orientation of forest policy is toward a sustainable management for all forests in the country but the analysis of how the policy is implemented on the ground by SFIs allow extracting helpful conclusions and strategic options for the future:

- SFEs are more concerned about getting the necessary wood sourced revenues (C1) to sustain their recurrent expenditures than to fulfil the sustainability goals. However, SFE don't excel in this direction, the monopolistic position discouraging sectoral competition and being an incentive for not seeking alternative solutions (e.g. innovative products/services).

- Public and merit good demand is perceived by SFI only from forest protective functions perspective (C2). The forest management tasks for all forests are established by the state, without consulting the society or the non-state owners. The imposed restrictions are not sufficiently supported through budget allocation for state forests nor compensations for non-state forests. This incentives SFE to prioritize production before protection and the non-state owners to not see their forests as an economic/social asset.

- The policy and regulatory frame favors, in general vague terms, the ecologically sustainable forest management (C3) but the performance in achieving this goal is only moderate due to the self-financing inefficient forest management structures. The forest management plans – considered as being the pillar of forest sustainable management in Moldova – tend to be less and less properly enforced, in order to allow higher revenues. The wood consumption is higher than the official supply, indicating the incapacity of SFEs to satisfy the demand and possible illegal logging incidence.

- Although the need for covering the recurrent expenditures and the need for investing in forest protection functions should incentives the forest management efficiency, our study indicates the contrary. SFEs are low technical productivity (C4) and low profitable (C5) entities, while the concern of the authority in this aspect is very limited. The same situation characterized the very low concern for innovative products and services (C6). Institutional reform that would allow a higher efficiency of SFE, as well as a more enabling environment for innovative products and services provision is highly recommended.

- Among the analyzed SFIs, Moldsilva aspires the most for the role of speaker for forestry and it is, in general, accepted as such (C7). The mediator role for all interest (C8) in forests is undergone together with SFEs activating at regional level. However, there are stakeholders that are almost not represented by Moldsilva, especially in the part of public.

The results of the study revealed that SFIs in Republic in Moldova are only partially succeeding in achieving the sustainability policy goals. The Government should seriously consider a more precise formulation of policy goals, with solid budgetary support along with institutional measures aiming at clearer institutional mandates, more efficient forest management structures and a higher concern for non-state forests and society demands.

CHAPTER 6. FOREST DEPENDENCY

6.1. Forest dependency assessment results

6.1.1. Income level

From the total 150 questionnaires completed, two were excluded from the study due to incomplete information provided by the respondents - one per each of the Ciorești and Borceag villages. The rest of the 148 questionnaires allowed us to continue processing data and assess the income level of the studied households. Following the centralization and processing of the information collected, a total income of 9,977,359 MDL resulted for 148 households (Figure 10). The average monthly income per person for the three localities is 2,710.7 MDL, which is comparable to the value of the same indicator for the rural population provided by the NBS for 2020 - 2,702.3 MDL (Talpă et al., 2022).



Figure 10. Total income and average monthly income per person

6.1.2. Sources of income

Analyzing the sources of income of the population in the villages concerned, the highest contribution to the total income is brought by salaries (including remuneration for unskilled work; Figure 11), the highest percentage resulting for the village of Ciorești.

Income from other sources is another category that has a significant share, 31% of the total income of 148 households. In the category of other incomes (Figure 12), pensions have a share of 48.2% (14.8% of total income), and remittances - 38% (11.7% of total income).

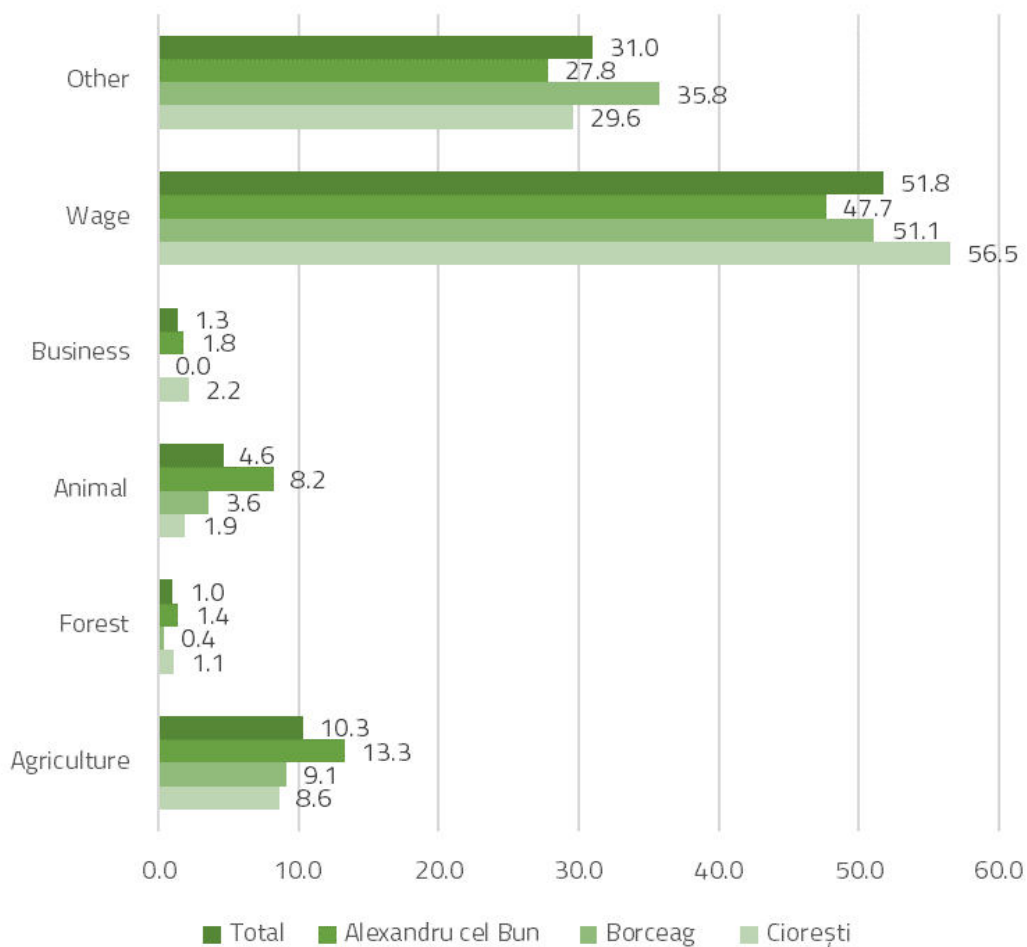


Figure 11. Annual sources of income and their share of total income

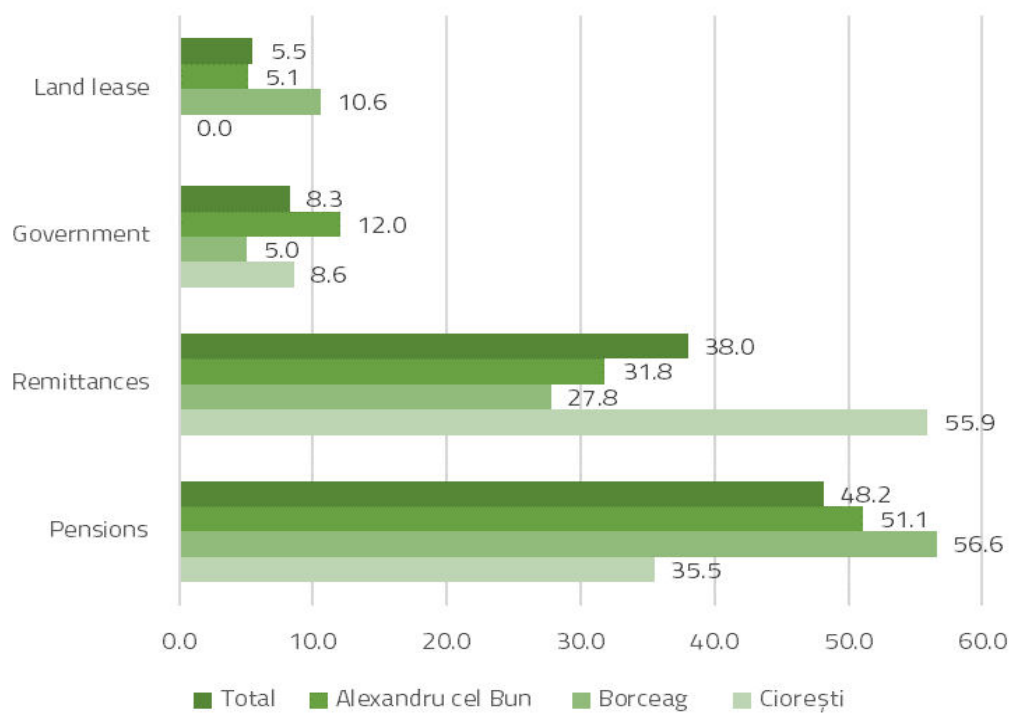


Figure 12. Annual revenues from other sources

The interest for business in these localities is low, having almost the same value as the income coming from the forest, the latter representing the lowest source of income for the local population from the sampled villages.

6.1.3. Forest products and their collection

Timber products are generally only accessible to people based on a commercial relationship with the forest managers. Only three cases were reported in the questionnaires where household members collected insignificant quantities of twigs/branches without paying for them, although most responded that this practice was not legal. In two other cases, branches were offered as remuneration for seasonal work, and in the remaining cases, branches were purchased. Most of the wood is purchased from state forest units or received as social aid (in case of Borceag village for firewood).

Table 7. Frequency and total value of forest products collected and procured

Category	Frequency		Total value	
	Number	% of households in the total number	Value	%
Firewood, of which:	140	94.59	779,200	87.55
Collected	11	-	35,200	-
Procured	129	-	744,000	-
Branches, of which:	8	5.41	14,070	1.58
Collected	5	-	4,950	-
Procured	3	-	9,100	-
Nuts	37	25.00	79,375	8.92
Mushrooms	41	27.70	10,340	1.16
Medicinal herbs	40	27.03	2,475	0.28
Dogrose	35	23.65	1,754	0.20
Forest fruits	9	6.08	1,405	0.16
Seeds	4	2.70	1,420	0.16
TOTAL	314	-	890,039	100

The NTFPs are generally available to locals (compared with restricted accessibility to timber resources), but only some (such as mushrooms, forest tree seeds, berries, and partly medicinal plants) are actually collected from the forests or trees. Walnuts, (*Juglans regia*), which have the highest total value (Table 7), are collected either from trees growing within households or shelterbelts along roads.

Wood is a heavy burden on rural households and a large share of local people's income goes to purchasing their required wood resources (Figure 13). The most disadvantaged are low-income households, with members spending 18.8% of their income on wood. Wealthier households are less affected, with only 3.9% of their income allocated to the purchase of firewood, although wood consumption is roughly the same for all social categories.

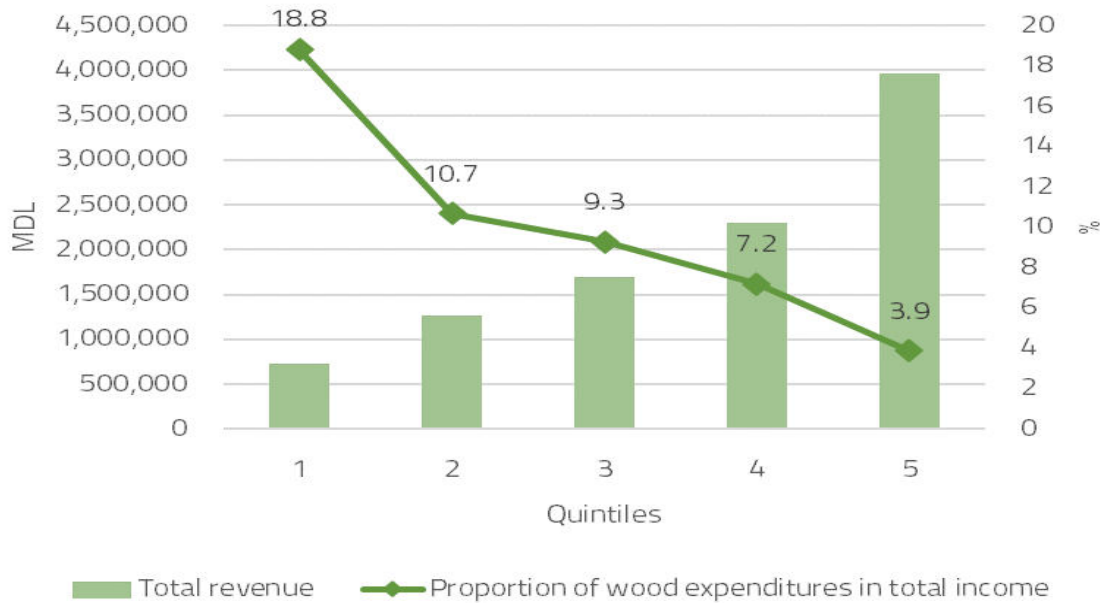


Figure 13. Proportion of expenditure on procured products (wood) in total income by income quintile

Table 8. The amount of firewood used in the last 12 months

Village	Number of households using firewood	Firewood, m ³	Average consumption, m ³
Alexandru cel Bun	48	230	4.8
Ciorești	46	283	6.2
Borceag	46	218	4.7
Total	140	731	5.2

The resulting wood consumption is 731 m³ for the interviewed households in the three localities (Table 8), approximately the same amount as in the case of the 2014 report - 718 m³.

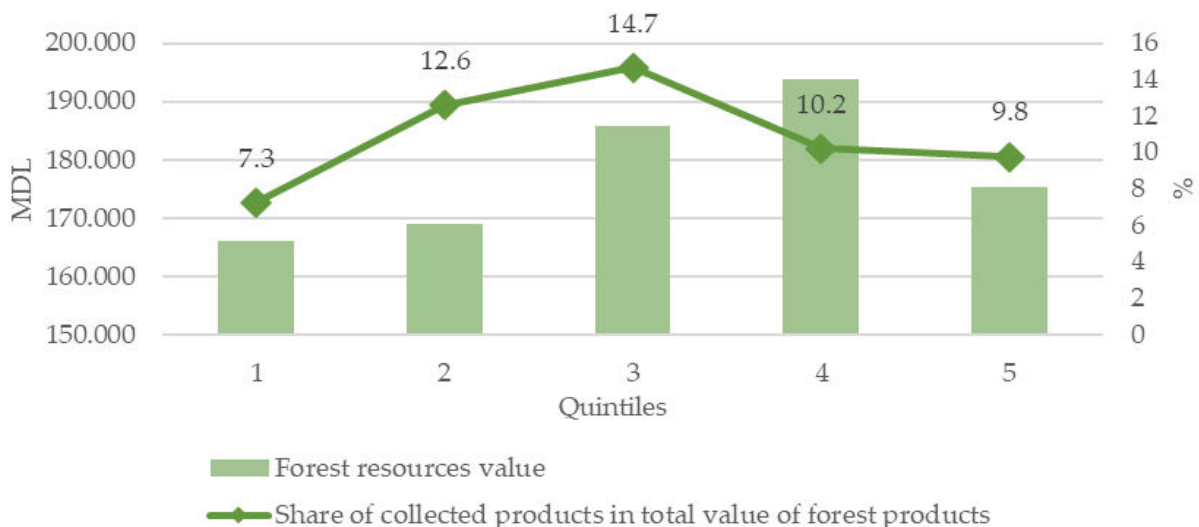


Figure 14. Share of collected products in total value of forest products (collected plus procured) by income quintile

As income increases, changes in the use of forest products follow (Figure 14), with wealthier households using more products. The share of forest products actually harvested and used is higher in middle-income households. However, the lower the household income is, the higher the dependence on the forest turns out to be, which is explained by the fact that forest resources constitute a significant share of the total income in the surveyed households (Figure 15).

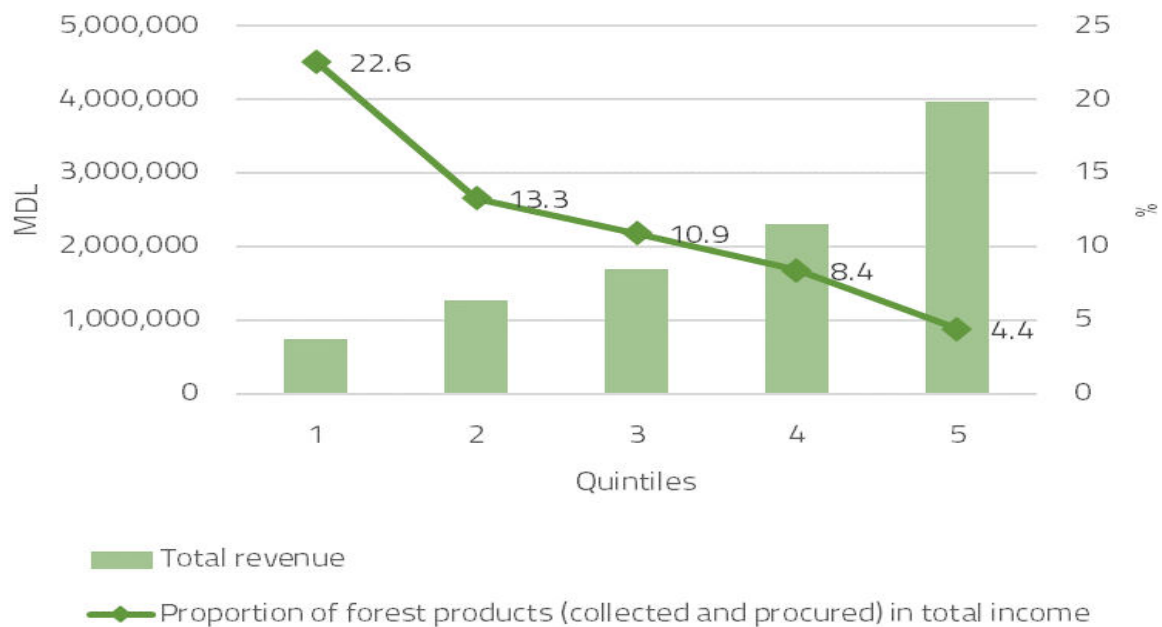


Figure 15. Dependence on forest (collected plus procured products) in total income by income quintile

Analyzing age distribution among household members per each of the five income quintiles, the average age of the household heads is the highest in the first quintile with most (70%) of them over 60 years old (Figure 16), but it decreases toward the fifth quintile with an average age of 52.7 years old. Regarding years of education, the average for the first quintile was 9.8 years with the highest score of the household head (12.3 years) in the fifth quintile, those with a higher income level.

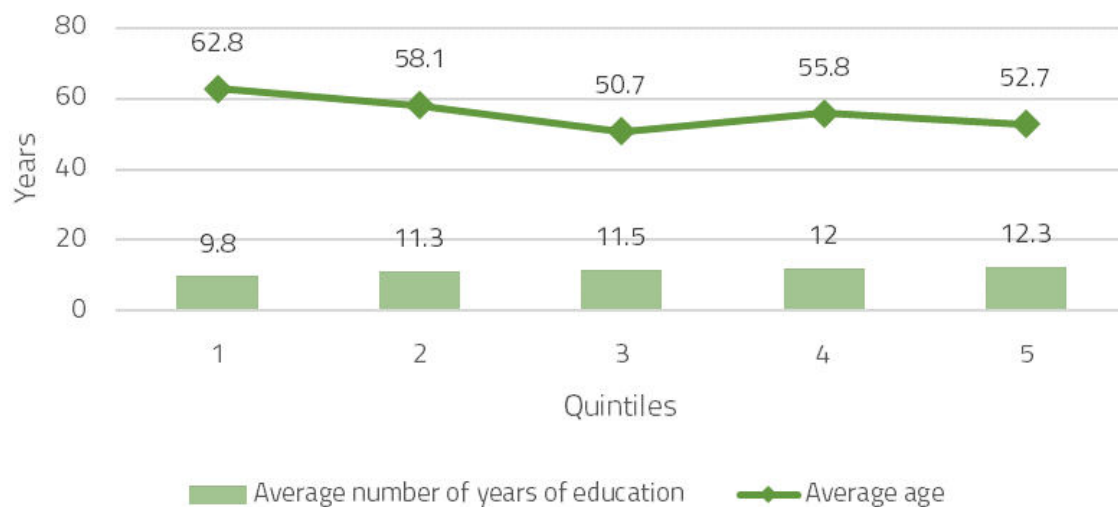


Figure 16. Average age and average number of years of education of the head of the household in households distributed over five quintiles of income

6.1.4. The role of services provided by forest ecosystems from the perspective of locals

In terms of provisioning ES supply, members of the households surveyed consider that the forest ecosystem primarily provides them with food (they collect mushrooms and berries), fresh water (springs are the main source of drinking water for their villages), and natural medicines.

Regulatory ES are highly appreciated by the surveyed population. It is generally perceived that forests can help regulate/control water quality, stabilize climate and water runoff, reduce natural disasters, combat erosion, enhance soil formation, improve natural water purification, and reduce costs for water treatment. Cultural services are also considered important as forests allow access for recreation, bearing a high aesthetic value and being important for cultural heritage too

6.2. Discussion

6.2.1. Dependence on non-timber forest resources

The people of Moldova have free access to NTFPs (unless it is for commercial use), but in our study, income from forest resources represented only 1% of the total income of rural households (Figure 11), compared to 11.3% in 2014 (while only income from non-timber resources was 6.6%).

The local population is not encouraged, nor are forestry enterprises motivated to develop the use of non-timber products. The lack of investments for the establishment of fruit crops and the maintenance of the present ones, for harvesting and further processing equipment, the presence of taxes that Moldsilva has to pay to the state for the collected products (Novac, 2018), result in decreased interest in these products. Moldsilva is based on self-management (HG, 2010), most of the expenses are covered based on revenues from the sale of products and the provision of various services, a mechanism considered destructive that leads to destabilization of the forestry sector (Lozan, 2021; Spitoc et al., 2021).

6.2.2. Dependence on timber forest resources

Firewood is a major social need, people have to pay considerable amounts for it compared to their factual income. The richer the family, the lower the share of expenditure in their total income. Firewood has been considered the most important wood product in all studies in the former Soviet countries (Bakkegaard, 2014), and access to this resource has been restricted in most cases.

6.2.3. Factors influencing dependence on forest resources

The availability of forest products that can potentially be obtained from the forestlands is the most influential factor of forest dependence (Zhyla et al., 2014), with such dependence being higher in regions surrounded by forests and isolated from large cities or infrastructure (Lazarava, 2014). The closer the community is to the forest, the more forest resources are used (Mehtiyeva, 2014; Arfin-Khan and Saimun, 2020). The present study confirms these considerations through the following arguments: (1) the share of forest resources used in total income is higher in households located at shorter distances from the forest, (2) households located near a richer forest resource use more firewood (as in case of Ciorești), and (3) fewer forest products are actually collected by local people if the forest is at a greater distance (case of Borceag).

The level of total income does not significantly influence the use of forest resources, especially as all households need firewood which is only available at high prices. At the same time, it is quite evident that lower-income households are dependent on the wood resource through the expenses they incur. The same trend can be identified if the quintiles distributed based on wealth are followed, so households with a more modest wealth are again those with the highest expenses. Differences can be seen in the level of products collected from the forest, so in middle-income households the quantity of products is higher. The quantity decreases toward the last quintile, due to the low value of these resources, so as the income of the locals increases, these resources are of less interest to them, and the dependence on the forest is lower (Ali et al., 2020). At the same time, the quantity decreases further towards the first quintile, where besides the lower income, the population is also older. Other studies indicate the same point when age is another important factor, so the older the people are, the less they harvest from the forest (Garekae et al., 2017; Ali and Rahut, 2018).

6.2.4. ES from a rural perspective

In forest dependency assessment studies, no cases were identified in which, in addition to questions about the income of members of local households from forest resources (Bakkegaard, 2014), questions were asked about their perception of ES, and namely whether they consider that they benefit from these services. This aspect is all the more important following the conclusion offered by the research carried out towards the evaluation of these services provided by the forest ecosystems of the Republic of Moldova, namely that, in the long run, the continuation of insufficient policies and non-priority investment in ES will cause long-term economic losses (Popa et al., 2013).

All the values associated with ES result from people's daily interactions with the environment they live in, so people perceive the environment primarily based on the socio-cultural setting (He et al., 2018). In our study, we assumed that the general appreciation and enjoyment of ES provided by forests among the members of rural households was rather high, at least at the level of the traditional human–nature connection. People's reliance on forest provisioning services for their livelihoods is rather well captured, especially in lower wealth groups (Ahammad et al., 2019). In our study, people directly indicated that other types of services are important too. For most Moldovans, picking a specific type of ES is directly influenced by their access to the main forest resource of their livelihood (which is firewood) and indirectly by the perception of a declined availability of non-timber resources. We noticed a general understanding among respondents who seemed to agree on the forests' key role to protect them from natural disasters. Cultural services are also deeply rooted in the traditions and culture of rural communities. Local populations recognize the aesthetic value that forests bring to the landscape, and that forests also play an irreplaceable role in the individuality of their own settlements. For communities, a forest in their immediate vicinity means a place of recreation, tranquility, inspiration, and education (children are traditionally taken on excursions to discover the beauty and diversity of nature).

6.2.5. Directions for strategies and policies in the Republic of Moldova

The need to develop better communication with the community is major (Budeanschi et al., 2013; Lozan and Rotaru, 2015). The community must be involved in forest management by: identifying its needs and ways to meet these needs, in a sustainable way, while diversifying sources of income,

carrying out institutional reforms mainly in the forestry sector (Budeanschi et al., 2013; Popa et al., 2016), the creation of infrastructure facilities (Chakraborty et al., 2017), and ensuring the transparency of legislative acts (in which anyone can participate in improving legislation; Lozan and Rotaru, 2015). Thus, initiatives related to the conservation of forest ecosystems not only remain in the phase of intention/concern, but also become possible to achieve. The forest can become a support for the population to motivate them to stay in the country, especially in the context of mass emigration in recent years (BNS, 2021). The relationship between the rural population and the forest can achieve a sustainable partnership with mutual benefits, especially from the perspective of poverty alleviation and forest expansion. Ecotourism can have an important impact in alleviating poverty (Hajjar et al., 2021), the presence of ongoing rural initiatives is a good factor, but ecotourism should be rational and friendly to nature (Lozan, 2021).

Besides securing revenues to state/local budgets, the forestry sector can be seen as a means of alleviating poverty in rural areas, including through energy/fruit plantations. The forestry sector can undoubtedly help meet social needs through improved livelihoods. However, it also provides opportunities to rehabilitate/restore degraded forests caused by former unsustainable practices, as nearly 80% of current Moldovan forests are of vegetative origin (Spitoc et al., 2021). This historic 'vegetative provenance' formed from grown sprouts of 2nd, 3rd, or even 4th regeneration phases are vulnerable to climate change, and thus inoppor-tune for the modern forestry sector where forest resilience will greatly depend on specific species vitality. Any proposed reconstruction/restoration or afforestation/reforestation initiative should never jeopardize peoples' lives but raise their morale and consolidate their capacities instead. Forest expansion, including through new energetic or fruit plantations, would very much encourage rural communities and allow them to become allies in sustainable projects (e.g., tourism, food forests, bioenergy, conservation, etc.). At the end, all this will help the rural population raise more income and improve their well-being, which will optimally assist the sustainability initiative alongside it.

6.3. Conclusions

- Although local communities do not earn income from forest resources, they are considered forest dependent, and because of their restricted access to forest resources, local people must extract considerable amounts of money from their income to substitute these forest resources;
- The highest dependency is identified among lower income households: with the level of family/household expenditure for wood (namely firewood) estimated at a very high share from the total income, it is difficult for this group to escape poverty when they must purchase wood at such a high price;
- Compared to 2014, with the increase of the average total income per person and the coverage of the subsistence minimum, but also with the decrease of the availability of non-wood products, the attractiveness towards the collection of these products decreased;
- The availability and distance from the forest resource influences the use of forest products. The greater the availability and the shorter the distance, the more products are used. Increasing income and education can reduce dependence on the forest;

- Wood for heating is the main product of the forest for which the dependence of the forest is manifested. Its use is energy inefficient;
- The annual consumption of firewood per household resulting from the research is confirmed by other studies and supports the idea of higher demand than potential supply, which should be taken into account by decision makers;
- Illegal logging can occur in many cases where the need for firewood is not met. Thus, there is an obvious need to look for ways to meet this need in order to achieve the conservation of the forest and biodiversity in general;
- It is necessary to involve the rural population and direct forestry policies towards an approach that integrates in discussions the main stakeholders - the rural population. Solutions must be cross-sectoral and have long-term approaches.

CHAPTER 7. FINAL CONCLUSIONS. ORIGINAL CONTRIBUTIONS. DISSEMINATION OF RESULTS. FUTURE RESEARCH DIRECTIONS

7.1. Final conclusions

The main conclusions of the research are:

- The ES concept is identified as an intermediary between the ecological integrity of forest ecosystems and human well-being. The concept is a good provider of information tools to communicate the importance of sustainably managing environmental resources by integrating science into decision-making, thereby contributing to improve policies;
- In the Republic of Moldova, the concept of ES has been included in several approaches, especially in the identification and quantification of services provided by forest ecosystems. These approaches remained without subsequent applicability, although they demonstrated significant benefits that would have been obtained in the medium and long term if a management aimed at a sustainable management of the forest resource had been implemented;
- Due to the self-financing mechanism to which Moldsilva is exposed, the achievement of sustainability objectives is positioned in the shadow of activities aimed at obtaining short-term income. Therefore, this should act as a motivation for forestry entities to look for ways to obtain higher incomes. In reality, the monopolistic nature discourages the search for alternative solutions, technical efficiency and profitability are reduced, and society and other stakeholders remain marginalized;
- An institutional reform (actually implemented), with well-articulated sustainability objectives, with a significant budgetary support from the state and with a clear delimitation of the SFI attributions, is paramount;
- Local communities in the Republic of Moldova express a high dependence on ES (especially for provisioning services). This dependence is expressed, first of all, by the significant proportion of the total income that they have to allocate to wood procurement, the poverty alleviation process having a slow evolution;
- Research has confirmed that the level of demand for firewood is above the level of supply. The increase in income obtained by members of local communities has reduced pressure on the use of non-timber resources, but that on timber resources continues to be high;
- There is an increasing need to integrate stakeholders, especially the local population, in the decision-making process and to identify opportunities to meet their needs. Only in such circumstances would counteracting illegal logging be effective and could an environment be created to ensure that the conditions for biodiversity conservation are met.

7.2. Original contributions

Although indirectly discussed in the forestry sector in the Republic of Moldova, the ES concept presents a novelty through the benefits it is able to bring to forest management through the elements of sustainability, but also through the benefits that contribute to human well-being. In this context, the carried out research makes the following original contributions:

- A detailed analysis of the tools for integrating the ES concept in the decision-making process was made, which aims to support the decision-makers to understand the methodological framework that describes the transition from ecosystems to sustainable policies through the ES concept;
- The researches carried out so far in the Republic of Moldova regarding the ES and the level of integration of this concept in the programmatic documents were analyzed;
- SFIs from the Republic of Moldova were analyzed in terms of their capacity to ensure sustainable management and their level of implementation of environmental policies;
- A quantitative analysis was performed that allowed the identification of the level of dependence of the members of the local communities in the Republic of Moldova, performing an analysis of the evolution over time of this factor;
- Recommendations were made on the need to integrate the ES concept and the main stakeholder (rural population) in the decision-making process, to improve the SFI in the Republic of Moldova so that they succeed in achieving sustainability objectives, the need and how to meet the ES demand of local communities.

7.3. Dissemination of results

a. ISI articles form thesis:

- Talpă, N., Hălălișan, A.F., Popa, B., 2021. Analysis of State Forest Institutions in the Republic of Moldova, Using a Causative Model. *Forests*, 12, 105. DOI: <https://doi.org/10.3390/f12010105>. Impact factor: 2,221.
- Talpă, N., Lozan, A., Hălălișan, A.F., Popa, B., 2022. Forest Dependence of Rural Communities in the Republic of Moldova. *Forests*, 13(6), 954. DOI: <https://doi.org/10.3390/f13060954>. Impact factor: 2,634.

b. ISI articles with the methodology of the thesis:

- Acharya, K., Talpă, N., Hălălișan, A.F., Popa, B., 2022. The Way Forward for Community Forestry in Nepal: Analysis of Performance against National Forestry Goals. *Forests*, 13(5), 726. DOI: <https://doi.org/10.3390/f13050726>.

c. BDI articles form thesis:

- Talpă, N., Tiță, G.C., Popa, B., 2019. Aplicarea conceptului serviciilor ecosistemice în sectorul forestier al Republicii Moldova. *Revista pădurilor*, 143(3), 001-056. Available from: http://revistapadurilor.com/wp-content/uploads/2019/06/Revista-Padurilor-3_2019.pdf.
- Mălai, M., Talpă, N., Popa, B., 2019. Evaluarea comparativă a Agenției Moldsilva și a Regiei Naționale a Pădurilor – Romsilva în baza unui model de analiză instituțională. *Revista Pădurilor*, 134(4), 001-050. Available from: http://revistapadurilor.com/wp-content/uploads/2019/06/Revista-Padurilor-nr.-4_2019.pdf.

7.4. Future research directions

The way forward is aimed at supporting the incorporation of the ES concept in the development of policies on forest management in the Republic of Moldova. This research can be a starting point for other future research directions, such as:

- Supplements with information for the identification and evaluation of ES in the Republic of Moldova, an updated study which, by providing more accurate data, provides decision makers with the support to identify ES that need to be supported or developed in the first place;
- Assessing the consequences of integrating the ES concept into environmental policies by describing and analyzing possible scenarios;
- Development of an ES evaluation guide at the level of protected areas in the Republic of Moldova, having the role of arguing the substantiation of the establishment of new protected areas;
- With the implementation of the reform in the forestry sector, this study can serve as a model for repeated evaluation of the SFI in the Republic of Moldova.

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