EUROPEAN UNION

GOVERNMENT OF ROMANIA

Structural Instruments
2007 - 2013

Romania

Climate Change and Low Carbon Green Growth Program

Component B Sector Report

Forest Sector Rapid Assessment

January 2014

Advisory Service Agreement between Ministry of Environment and Climate Change and the International Bank of Reconstruction and Development

Beneficiary: Ministry of Environment and Climate Change

The World Bank
Europe and Central Asia Region

Project co-financed by the European Regional Development Fund through OPTA 2007 – 2013

Table of Content

Abbreviations and Acronyms

APPR	Romanian Forest Owners Association
BAU	Business as usual
CO2	Carbon dioxide
EARDF	European Agriculture and Rural Development Fund
EFISCEN	European Forest Information Scenario Model
EFI	European Forest Institute
ESIF	European Structural and Investment Funds
ETS	Emission Trading System
EU	European Union
FMP	Forest Management Plan
GDP	Gross Domestic Product
GDPSPWFF	The General Directorate for Policy, Strategies and Projects for Waters, Forestry and Fisheries
GHG	Greenhouse Gases
INM	National Institute for Meteorology
ICAS	Institutul de Cercetări şi Amenajări Silvice
JRC	Joint Research Centre of the European Commission
LULUCF	Land use, land use change and forests
MARD	Ministry of Agriculture and Rural Development
MECC	Ministry of Environment and Climate Change
NFA	National Forest Administration - Romsilva
NFI	National Forest Inventory
NRDP	National Rural Development Plan

NTFP	Non timber forest products
PFD	Private Forest Districts
SCF	Structural Cohesion Funds
SCI	Sites of Communitarian Interest
SEM	Sustainable Ecosystem Management
SMEs	Small and Medium Scale Enterprises
SOP	Structural Operational Programme
SWOT	Strength, weakness, opportunities and threats
tCO2e	Tonne of CO2 equivalent
TEEB	The Economics of Ecosystems and Biodiversity

Acknowledgement

The report was prepared by a core team comprised of Diji Chandrasekharan Behr and Bogdan Popa with inputs and comments from Andrew Mitchell. It is an output of the World Bank's Romania Climate Change Reimbursable Advisory Service (RAS) Program at the request of the Government of Romania (through its Ministry of Environment and Climate Change). This sector report benefited from the comments and suggestions of John Fraser Stewart and Stig Johansson. It was reviewed and cleared by Kseniya Lvovsky.

The work was carried out between June 2013 and September 2013 and is based upon the results of extensive discussions with and information from officials and stakeholders in the forest sector including: Gelu Puiu (Secretary of State – Forests, Ministry of Environment and Climate Change, Department for Water, Forests and Fisheries), Irina Rusu (Counsellor, Ministry of Environment and Climate Change, Department for Water, Forests and Fisheries), Dănuţ Jacob (Director, Ministry of Environment and Climate Change, Department for Water, Forests and Fisheries), Sebastian Constantin (Counsellor, Ministry of Environment and Climate Change), Ciprian Pahonţu (Policy Adviser, National Forest Administration-ROMSILVA), Ovidiu Badea (Scientific Director, Forest Research and Management Institute (ICAS)), Diana Silaghi (Scientific Secretary, Forest Research and Management Institute (ICAS)), Maria Faina (GHG Inventory Expert – Forestry), Diana Zidaru (GHG Inventory Expert – Forestry), Mihaela Năstase (Referent, National Forest Authority, Protected Areas Unit), Marian Drăgoi (Professor, Faculty of Forestry, Stefan cel Mare University from Suceava), and Emil Sandulescu (Counsellor, Ministry of Agriculture and Rural Development).

The World Bank Team would also like to express gratitude to the Romanian Government for the excellent working relations established during this assignment and especially the assistance of the staff and members of the Project Implementing Unit in the Ministry of Environment and Climate Change, namely Bianca Moldovean, Mihaela Smarandache, Narcis Jeler, Alexandra Ulmeanu, and Gabriela Popescu.

The Climate Change program is managed by Jian Xie and Erika Jorgensen, under the guidance of Laszlo Lovei, Mamta Murthi, Kulsum Ahmed, Satu Kristiina Kahkonen, and Elisabetta Capannelli in the World Bank.

Executive Summary

1. The Forest Sector Rapid Assessment reviews key issues in the forest sector to determine how the sector can contribute to mitigating and adapting to climate change. The assessment reviews the sector ministries proposed measures for the 2014-2020 Structural Operational Programs (SOPs) and National Rural Development Plan (NRDP) to determine whether they are climate positive. The latter is an important condition for using EU Structural Cohesion Funds (SCF) for 2014-2020.

2. The Assessment identifies operational programs and sector plans that can support the climate change objectives and fulfill the EU *ex ante* conditionalities for the SCF (2014-2020). The Assessment also provides a basis for refining the proposed measures in order to respond to the climate change requirement. The Assessment is based on available information in published literature and limited data on costs and benefits of different forest management approaches. Due to data limitations, the report does not prioritize among the proposed measures. The next phase of the reimbursable advisory service will involve more in-depth work on the sector, offering more specific recommendations.

Forest Sector Key Characteristics

3. Romania's forests roughly 27 % of the country land surface (MECC, 2012). Most of Romania's forests are secondary forests and are distributed across the mountains, hills, and plains of the country. Romania is relatively rich in biodiversity and has the largest remaining tract of contiguous natural and naturally regenerated forest because of their current management practices. Romanian forests are used for protection and production purposes.

4. National regulations and technical requirements, and five major management principles structure forest management in Romania. Forest management plans (FMPs) are valid for 10 years, must include management prescriptions for each forest stand, be prepared by specialized forest management planning companies, be approved by the national forest authority and must be implemented in practice. The prescriptive regulatory and technical requirements and restrictions on uses limit flexibility and innovation (which are increasing elements of best forest practice worldwide) and result in costs that can reduce the profitability of sustainable forest management for some private forest owners, especially smallholders.

5. In 2010, the forest sector and wood industry contributed 3.5% of GDP (INS CON 105D). Furniture exports were 3.45% of national exports, and the forest sector was 7% of national exports. The forest sector is also an important employer in rural areas, formally employing approximately 143,000 people in 2011.

6. Implementation of the land restitution legislation resulted in 66% of the wooded land areas were in the public domain while 34% were privately owned in 2009. There are an estimated 850,000 forest owners in Romania, including individuals, indivisible communes, and churches, owning small and large tracts of

forests. Approximately 40% of the area under private ownership is managed by smallholders. Restitution has had implications for forest management including meeting objectives of Natura 2000, as 36% of Natura 2000 sites are on private lands. While the total area under smallholder is less than 20% of the total wooded land area, the parcels are scattered around the country. Motivating private landowners to comply with sustainable management requirements is important to maintain the health of forests. Furthermore, inclusion of small private landowners is also important for meeting the objectives of the SCF.

Forests and Climate Change

7. Forests are important for sequestering greenhouse gases (GHGs) and reducing emissions, thus mitigating climate change. Romania's GHG Inventory (National Inventory Report) from 1989 to 2011 stated that "[i]n 2011, the GHG emissions without [land use, land use change, and forests (LULUCF)] have decreased [by] 54.86% comparing with the base year level." When factoring in LULUCF, "the net GHG emissions/removals (taking into account the carbon dioxide (CO2) removals) decreased [by] 61.05 %." (MECC, 2013). To maintain forests' contribution to GHG emission removal, it is necessary to maintain the health of forests.

8. Forests, like other natural systems, are affected by climate change. Projected decrease in precipitation and increases in temperature are anticipated to reduce the health of forest systems, and increase their vulnerability to pests and other biotic factors. This is turn could degrade forests reducing their ability to sequester carbon and increasing the likelihood that forests become a source of CO2 emissions. Less suitable climatic conditions and associated biotic pressures are also expected to decrease tree growth by approximately 30%. Decreased growth will reduce the ability of forests to sequester carbon and will have economic ramifications[1].

Using Forests to Adapt to and Mitigate Climate Change

9. Forests provide supporting, provisioning, regulating and cultural services. These ecosystem services support human wellbeing at the local, national, regional and global level, including through the sequestration of GHGs and mitigation of climate change. Forests, therefore, play an important role in strengthening societal adaptation to climate change as they provide critical ecosystem services, such as wood, non-timber forest products (NTFPs), and watershed hydrological regulation, the values of which are usually underestimated by society ('forests for adaptation'). Forests structures, species, and species distribution, however, are being modified by climate change. Responding to this requires adaptation of forests themselves in order to prevent degradation of forest resources and to protect the ecosystem services that society relies on for its adaptation.

[1] There is inadequate data to assess the potential economic impacts, and a 30% decrease in growth cannot assumed to be a decrease in contribution to GDP by a third (i.e., roughly 1.3% of GDP) as value addition is not accounted for.

Opportunities through Sustainable Management of Production Forests

10. Sustainable management of production forests could contribute to mitigating climate change through naturally regenerated stands sequestering carbon and reduced occurrence of pests or other biotic factors that degrade forests. In Romania, management and harvesting of forests must comply with legal requirements and technical parameters regardless of the size of the forest, type of forest, or ownership status. As indicated earlier, for small forest landowners meeting these requirements can be onerous and reduce the profitability of sustainable forest management (SFM) given the current market for forest products.

11. To foster sustainable management of production forest under private ownership, the government should consider: (i) offering guidance for sustainable forest management rather than prescriptive legal and technical requirements, fostering innovation, (ii) simplifying rules for administering forests, (iii) providing technical support for innovating in forest management, harvesting and value addition, (iv) offering incentives and opportunities for smallholders to associate and benefit from economies of scale, and (v) improving and extending road access in production forest areas. Well planned and maintained road access can make a positive contribution to mitigating climate change as it enables forest management, continuous monitoring of forest health, and assists in preventing and putting out fires and pest infestations (both of which can release CO2).

Opportunities through Enhancing Management of Protected Area Management

12. Maintaining protection forests that promote sustainable use of resources can enhance resilience of the forests, help preserve biodiversity, and reduce carbon emissions. Romania has an obligation to meet the directives associated with Natura 2000. Facilitating management of existing protected areas and Natura 2000 sites with forests can help reduce carbon emissions from degradation of these sites. The extent of carbon sequestration, however, will be lower in those sites where the trees are of an older age class.

13. Two actions that would enhance management of protected areas and Natura 2000 sites. The first is providing the necessary resources to develop management plans and review, approve and implement management plans for protected natural areas. In 2012, only 5 management plans of the already drafted 272 management plans were approved. This will require rectifying the limited administrative capacity to approve management plans (approximately 50% of protected natural areas are under the National Forest Administration), fostering management practices that reconnect natural areas that have been artificially divided and form a functioning network, and restoring degraded natural areas.

14. The second action requires determining how to most effectively ensure compliance with Natura 2000 – with incentives, regulations, technical support, purchasing privately owned Natura 2000 sites or a combination of these. For example, the national forest authorities should examine the feasibility of using regulatory changes that require forest owners and managers to take into account Natura 2000 values in forest management plans and in forest management as an alternative to compensation. Current challenges include multiple requirements for managing Natura 2000 sites (Natura 2000 requirements and

forest management plan requirements), unclear or complex conditions for private owners to be eligible to receive compensation, and lack of compensation for community held properties.

Opportunities through Afforestation

15. Increasing area under tree cover can increase carbon sequestration, especially during the early stage of tree growth (after the initial years). Preliminary results of the degraded lands inventory (for 16 out of the 41 counties) identified approximately 115,129 ha as suitable for improvement through afforestation (MARD, 2012). Degraded areas or agricultural areas that are not suitable for cultivation are scattered throughout the country. The opportunities for afforestation that are being by the national forest authorities are largely abandoned agricultural areas in the southern belt of Romania.

16. Afforestation involves upfront costs and inputs that are often beyond the reach of small landowners. Availability of financial resources to support such activities is important. This can be provided as compensation for lands being included within a national afforestation program that aims to plant contiguous parcels of land (referred to as forest belt in Romania). Financial support can also be provided to individual interested in afforestation through appropriate credit opportunities. In addition, the 'infrastructure' for afforestation must be in place. The country must have increased capacity for seedling production, technical support, accessible data and information on species suitability.

17. Funds for the National Programme for Afforestation are currently available from the requirement that forest administrations set aside 15% of their timber revenue. The National Environmental Fund also provides financial resources to afforest degraded lands. EU accession resources are also available for afforestation. Recent efforts suggest that the available funds are inadequate for effectively implementing the program. In addition, greater awareness among landowners regarding the resilience and climate benefits of afforestation is needed.

Proposed Measures for 2014-2020 Programming and Recommendations for Refining the Measures

18. The contribution of forests to GHG emission reduction and resilience of the forest and other sectors to climate change requires sustainable resource management (keeping the forest system healthy and trees growing). In Romania this requires addressing many of the policy and regulatory challenges, providing adequate institutional and technical support, and lifting constraints created by poor road access, limited financial support, or knowledge. The SOPs offer an opportunity to create the needed enabling conditions.

19. The Delegate Ministry on Forests has identified the following measures from the forest sector for the upcoming SOP programming cycle (2014-2020):

Measure	Funding requested (€ million)	Linkage with opportunities to use forests to mitigate climate change

Improving forest accessibility by maintaining and building forest roads and other accessibility facilities (article 18 in the EU Regulation for programming 2014-2020 CSF)	700	Linked to opportunities associated with production and protection of forests
Implementation of Natura 2000, afforestation, and establishment of forest belts (article 31, 35)	300	Linked to opportunities associated with protected forests and afforestation
First afforestation of agricultural lands[2] (article 22)	2500	Linked to opportunities from afforestation
Investments in new technology, and in processing and marketing of forestry products (article 22)	250	Linked to opportunities associated with production and protection forests and afforestation
Training and consultancy (article 15 and 16)	70	Linked to opportunities associated with production and protection forests and afforestation
Support for organizing the supply chain in forestry	50	Linked to opportunities associated with production and protection forests and afforestation
Insurance and mutual funds in forestry	45	Mostly linked to afforestation
Support for innovation and collaboration	15	Mostly linked to opportunities associated with production and protection forests

20. The first four proposed measures associated with article 18, 22, 31, and 35 can directly contribute to sequestering CO2 and reducing their emissions. Sustainable management of production and protection forests can contribute to reduced emissions by maintaining forest health through thinning and management of older stands. SFM also contributes to CO2 sequestration through regeneration of new stands, and wood from the thinning being used in carbon beneficial processes (e.g., replacing fossil fuels or stored in chipboard). Investing in technologies that include the latest nursery technology or integrating

[2] This provides financial support to eligible public authorities and private entities to cover establishment and maintenance cost of afforestation of agricultural lands.

logging and processing or improving marketing of high value added products will help reduce waste, lower costs, and enhance returns from SFM. Therefore, these measures, if properly implemented, would have positive climate relevance.

21. There is limited data for determining whether the measures that provide training, support for the supply chain in forestry, insurance and mutual funds, and support for innovation and collaboration for forest owners will have a positive or negative impact on net CO2 removals. Where the measures do not directly contribute to an increase in CO2 sequestration they, if implemented appropriately, are unlikely to result in an increase in CO2 emissions. For example, the measure on training and consultancies would assist new forest owners to build required capacity in best SFM practices. The measure on insurance is targeted at reducing risks associated with the upfront investments associated with afforestation efforts. The insurance helps cover losses resulting from the occurrence of natural disasters. The measure on innovation and collaboration is helpful to develop new technical guidelines including guidelines for sustainable adaptive measures for climate change.

22. The Delegate Ministry on Forests has proposed funding amounts for each measure, with a total value of €3.93 billion. This amount is well in excess of the total funding anticipated for the overall NRDP. As a consequence several of the measures may not receive the desired amount. Using available qualitative and quantitative data, the rapid forest sector assessment makes recommendations for refining the measures and enhancing their positive impact on mitigating climate change.

Recommendations for Refining the Key Proposed Measures

23. The **measure on improving road access** will be fundamental for ensuring forests help mitigate climate change because of the net benefits for SFM. To effectively deliver positive climate outcomes with this measure it will be important to:

- To ensure that the roads that are rehabilitated and the new roads constructed improve the contribution of forests to carbon sequestration, by ensuring the eligibility criteria are inclusive of all the entities managing forests and require a clear indication of the potential reduction in GHGs as a result of the project;
- Financing provided for forest roads should be based on the economic rationale and direct and indirect contribution to climate change mitigation (including based on rough estimates of carbon sequestration or accumulation in the medium term) - the investments made through this measure should result in benefits that would not have arisen without the measure;
- Consider the current distribution of markets and capacity for timber harvesting and processing; and
- Raise awareness about the opportunity for financial support for road rehabilitation, maintenance and construction, including using the networks available to the forest associations.

24. The current funding request of €700million, while seemingly significant, would (using data from the previous programming period) allow for rehabilitation of roughly 7500 km of road. This would augment

the rehabilitated roads by 2.5m/ha of production forest or 1.15m/ha overall. This addition still leaves Romania well below accessibility levels found in other comparable EU28 member countries. A more detailed analysis is needed to determine how much of the total available funds for the sector should be reallocated to this measure while ensuring it remains feasible to implement.

25. The **measure on investing in new technology, marketing and processing** is well justified because it helps forest companies that have not upgraded their technology, improving SFM and having positive impact on soil and efficiency of management. It will also increase efficiency and improve value-addition and revenue from these products. To ensure this measure delivers positive benefits, the agency should:

    - Give priority to co-financing environmentally friendly technologies;
    - Ensure that if technologies are being "imported", support is provided to adapt them to the conditions under which SMEs are operating in Romania;
    - Encourage the development of new technologies within Romania; and
    - Provide information regarding what "environmentally friendly" entails;

26. The extent of private ownership of forests requires adequate policy measures and incentives for small and large private forest landholders to comply with the national objectives for forest resource management. This is especially the case for areas for protection that are designated Natura 2000 sites, of which 36% are on private landholdings. Prior to finalizing the **measure on Natura 2000**, it is necessary to assess the suitability of using compensation to improve compliance with Natura 2000 requirements. Use of compensation should be compared with the use of forest legislation to achieve Natura 2000 objectives (as is done elsewhere in Europe), and the possibility of using the funds to purchase private lands that are designated Natura 2000. Furthermore, the feasibility of compensation should be examined as EU regulations require a clear articulation of additionality to complying with Natura 2000 requirements to justify provision of compensation. If a compensation measure is put in place, it should involve a simple and straightforward mechanism for providing compensations. The funds should be accessible to all stakeholders groups, and the selection process must be inclusive.

27. Given the increased awareness of Natura 2000, the sector will be able to deliver on this measure more effectively during this programming cycle. Additional awareness raising, however, needs to be done among small landowners who would be eligible for the compensation payments. Furthermore, there is the need to address the institutional issues that constrained effective administration of the measure on Natura 2000 during the last programming cycle.

28. There is limited data to assess appropriateness of the requested funding allocation (€2.5 billion) for this measure. Based on 2009 data, an allocation of €150 million would provide all private landholders with Natura 2000 sites with compensation at 2009 levels. Determination of the appropriate funding level for this measure requires updated estimates of the cost of administering and monitoring Natura 2000 activities, cost for afforestation of degraded lands, establishment of forest belts, and provision of compensation payments.

29. The **measure for Natura 2000, afforestation, forest belts,** should be disaggregated and the afforestation, forest belt activities should be merged with the first afforestation of agricultural lands. Use of funds for afforestation projects should prioritize geographic areas where the activity can generate multiple benefits such as combatting desertification and improving degraded lands. For example, some areas in south-east Romania are more suitable for afforestation and would significantly benefit from such investments. Another approach would to determine where to support investments in afforestation based on their potential benefit to adapting agriculture to climate variability.

30. The **measure on first afforestation of agricultural lands** can also help mitigate and adapt to climate change by enabling CO2 sequestration and contributing to resilience to climate change. The funding requested for this measure (€250 million) could enable the afforestation of approximately somewhere between 38,000ha and 100,000 ha (depending on where the projects are implemented). This is an ambitious target, and will require establishing and effectively using existing supporting services (from private or public sector) such as availability of good quality seedlings and extension support. In addition, there is need to:

- Prioritize afforestation projects based on areas with high potential and notable co-benefits;
- Keep the application and eligibility requirements clear and simple;
- Adopt inclusive criteria for eligibility;
- Ensure a significant portion of the upfront costs are covered with this measure;
- Improve the implementation arrangements for this measure, drawing on lessons from previous attempts to implement afforestation; and
- Raise awareness.

31. The impact of forestry measures requires time. Steps should be taken to put the necessary supporting systems in place to avoid any further delays (e.g., afforestation measures will initially require increased capacity for seedling production). This reality underscores the importance of initiating the measure early in the programming cycle to achieve the desired outcomes and envisaged impact on GHG emissions.

32. The sector should also consider integrating measures for forests in other SOPs, where appropriate. For example the conditions necessary for research could potentially be delivered as part of other SOPs that have a focus on research. Additional examples include opportunities to integrate elements of the measures on afforestation into the NRDP measures for agricultural land; building climate resilience of infrastructure would include measures to maintain forests on slopes to mitigate landslides and reduce soil erosion; diversifying the energy mix (especially in rural areas) to include biomass based energy, helping shift to a low carbon energy portfolio.

33. In summary, the General Directorate of Forestry proposed measures comply with the EU requirement that 30% of the allocated funding have positive climate relevance. The measures with the larger funding request enable sustainable forest management. Several of the measures require additional funding to bridge the gap between current situation and optimal potential. The proposed funding levels, however,

are more realistic given the targets that will need to be met (with the exception of the proposed funding for Natura 2000, afforestation, and forest belts).

34. An advantage of investing in the forest sector for mitigation is the co-benefits from SFM of production and protection forests. Improved forest management practices that internalize the potential impact of climate change can build the resilience of forests to climate variability, enhance the resilience of other sectors (e.g., agriculture), restore degraded lands, and provide a source of renewable energy for rural areas that has a low carbon footprint. Sustainable management of forests is instrumental for achieving Romania's international obligations and EU directives.

35. Providing support for the forest sector through the NRDP and SOPs can be a "no regrets" investment. Many of the measures in the forest sector can jointly address mitigation and adaptation issues (e.g., afforestation of degraded lands). It, however, is important to ensure they do not have unintended consequences (e.g., decrease in CO2 removal). Monitoring change in carbon sequestration and monitoring harvesting and planting using some of the recently available technology and low cost system would assist in preventing negative outcomes.

1. INTRODUCTION

36. Romania, as a new European Union (EU) member state, has obligations to comply with EU directives and meet the EU 2020 targets. The EU 2020 has several targets that are of relevance to environment and forests. The most evident are the biodiversity and climate change and energy targets. On climate change the commitment is to reduce greenhouse gas emissions by 20% (and where conditions permit, even 30%) lower than 1990. The EU 2020 biodiversity targets including fully meeting the bird and habitat directive (Natura 2000), aim to maintain and enhance ecosystems and their services by establishing green infrastructure and restoring degraded ecosystems, increasing the contribution of forestry to maintaining and enhancing biodiversity by using suitable instrument for sustainable forest management (drawing on funds from the rural development fund), control invasive alien species and help avert global biodiversity loss.

37. Romania has set a target requiring that emissions from non-Emission Trading System (ETS) sectors be no more than 19 percent higher in 2020 than in 2005. To respond to the Biodiversity Targets, four general directions for action were stated in the National Strategy and National Action Plan on Biodiversity Conservation (2013-2020) which includes: (i) halting the decline of biodiversity, conserving ecosystem and landscape and restoring degraded systems, (ii) integrating biodiversity conservation policy into all sector policies, (iii) promoting innovative traditional knowledge, practices and methods and clean technologies in the conservation of biodiversity, and improving communication, and (iv) increasing education in the field of biodiversity.

38. Romania relies on the European Structural and Investment Funds (ESIF) to achieve its commitments to the EU2020 Targets. The use of the European Agriculture and Rural Development Fund (EARDF) requires that at least 30 percent of the budget allocated for rural development (as part of the National Rural Development Plan (NRDP) be spent on the environment and addressing climate change.

39. The Commission Green Paper on Forest Protection and Information in the EU: Preparing Forests for Climate Change (2010/2106(INI)), states that forests should be considered a major solution to the climate crisis and emphasizes that sustainable forest management is of pivotal importance for the EU to achieve its climate goals while maintaining its ecosystem services. This Green Paper underscores the point that most expenditures categories in the forest sector are likely to have significant positive climate relevance. Forests also can help make the shift to a low-carbon economy and can play an important role in building resilience of other sectors to climate change (i.e., through ecosystem based adaptation). Activities in the sector aimed at meeting Romania's EU commitments to the biodiversity and climate EU2020 targets can also offer co-benefits to meeting the country's obligations with regards to the EU 2020 targets on employment and reduction of poverty and social exclusion.

40. The Rapid Forest Sector Assessment (Assessment) aims to inform how to ensure that measures proposed in forest sector for the 2014-20 Operational Programmes have climate relevance. These operational programs are the basis for using EU funds (2014-2020). The Assessment reviews key issues in the forest sector to determine how the sector can contribute to mitigating and adapting to climate change. It also provides a quick review of the economic and institutional issues in the sector that influence how resources are used. The assessment reviews the responsible entities' proposed

measures for the 2014-2020 Structural Operational Programs (SOPs) and National Rural Development Plan (NRDP) to determine whether they are climate positive. The latter is an important condition for using EU Structural Cohesion Funds (SCF) for 2014-2020.

41. The Assessment identifies operational programs and sector plans that can support the climate change objectives and fulfill the EU *ex ante* conditionalities for the SCF (2014-2020). The Assessment also provides a basis for refining the proposed measures in order to respond to the climate change requirement. The Assessment is based on available information in published literature and limited data on costs and benefits of different forest management approaches. Due to data limitations, the report does not prioritize among the proposed measures.

42. The assessment draws on available data to review the contribution of the sector to climate change and assess how proposed measures for the National Rural Development Plan (NRDP) and measures on environment (in SOP infrastructure) could most effectively contribute to meeting the objective of having 30% of the allocation contributing to climate positive outcomes. The assessment is based on available information in published literature and limited data on costs and benefits of different forest management approaches. Due to data limitations, the report does not prioritize among the proposed measures. The next phase of the reimbursable advisory service will involve more in-depth work on the sector, offering more specific recommendations.

2. FOREST SECTOR IN ROMANIA – BACKGROUND

43. Romania has the largest remaining intact tract of contiguous natural and naturally regenerated forests in Europe. Romania's forests cover 6.515 million ha (27.3%) of the country land surface (MECC, 2012), of which 225,000 ha are listed as primary forests (MECC, 2011) and the rest as secondary forests. Romania's current forests are a result of the silvicultural and management practices adopted by the government. These past investments are likely to have supported the maintenance of vast tracts of forests, enhancing the provision of ecosystem services more broadly. Forest cover in Romania, however, is well below the EU-27 average of 42% (World Bank, 2011). Current forest cover is also slightly more than half of what is envisioned as the national target level (40%).

2.1 Biophysical characteristics

44. Key characteristic of Romania's forests that shape the link between climate change and forests are distribution of forests, species composition and age class distribution. The percentage of forests in each of these categories is show in Table 1 below:

Table 1: Percentage of Forests in Different Categories (source: MECC, 2012)

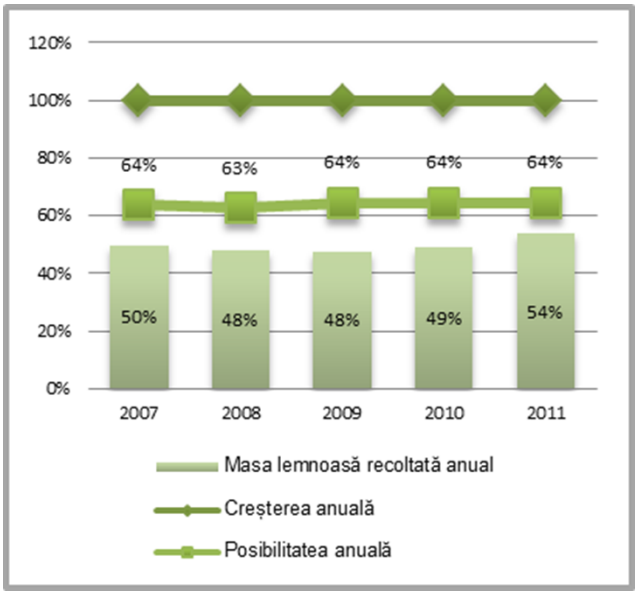
Distribution of forests	Percentage
Mountains	52
Hills	37
Plains	11
Species Composition	
Coniferous	31
Beech	31
Oak	18
Other	20
Age Class Distribution	
Less than 20 years	23
21-40 years	19
41-60 years	18
61-80 years	15
81-100 years	10
More than 100 years	15

45. Coniferous forests (especially spruce fir), mixture forests (beech, fir-tree, spruce fir) and beech forests are found in the mountains. Higher peaks are covered by alpine lawns and bushes of dwarf pine, juniper, bilberry, and red bilberry. Broad-leaved forests, composed of beech, common oak and durmast oak are found in the hills and plateaus. *Quercus cerris* and *Quercus frainetto* are found in the low plains. (MECC, 2012)

46. Romania is relatively rich in biodiversity with 3,700 plant species[3], 33,792 animal species have been identified, out of which 33,085 invertebrates and 707 vertebrates (Ministry of Forestry, 2010 as cited by Centre for Climate Adaptation (2013)). The Danube Delta covers an area of 580,000 ha (2.5% of Romania's surface). It is the largest wetland in Europe and important for water purification. 312 important bird species are present in the Delta. It is also one of the last remaining habitats for the European mink, the wildcat and the freshwater otter (http://www.climateadaptation.eu/romania/biodiversity/, viewed 2013).

47. The total forest growing stock is estimated as being 1.413 million cubic meters (m^3). Of this volume, 39% is coniferous, 37% is beech, 13% are oaks. Average volume per ha is 218 m^3/ha while the European average is 147 m^3/ha. Annual increment is estimated at 5 m^3/ha. The annual allowable cut is around 22.3 million ha. In 2012, however, removals from the forests were 15.3 million ha, basically due to reduced accessibility. In 2012 removals accounted for approximately 48 % of the growing stock volume increment and 68.6% of the annual allowable cut (see Figure 1 below for relation between annual cut, annual allowable cut and annual increment in previous years). The species composition of the maximum volume of exploitable wood is 45% beech, 24% softwood, 13% various hardwood, 10% oak and 8% various softwood species (Bohateret, 2012).

Figure 1: Comparison between annual cut (column), annual allowable cut (squares) and annual increment (diamonds) of Romanian Forests (source MECC, 2013)



2.2 Functional Classifications

[3] Of these 74 are extinct species, 39 are endangered species, 171 are vulnerable species and 1253 rare species.

48. Based on the provisions of Forest Management Plans (FMP), 53.3% of the Romanian forests are included in the protection forests functional category, of which 43% serves soil protection, 31% water protection, 5% flood protection, 11% includes forest with recreation functions and 10% are forests with scientific interest. The remaining 46.7% of the surface is production forest (MECC, 2012). From the management point of view, Romanian forests are split in 6 functional types: Type I – 2% - no silvicultural interventions, Type II – 20% - conservation interventions, Type III – 8% and Type 4-20% - silvicultural interventions are promoting natural regeneration and Types V – 5% and VI – 45 %, all types of silvicultural interventions are permitted.

49. The Romanian Network of Protected Areas (which includes areas of national importance, reserves, parks and Natura 2000 sites) covers approximately 23% of the forest area. Excluding the Danube Delta Biosphere Reserve there are 13 national parks and 14 nature parks (Ioja et al., 2010). These 27 large protected areas include 134 nature reserves and natural monuments, and covering 1.17 million ha. More than 693 nature reserves and natural monuments are outside the large protected areas and cover 102,534 ha (Borlea et al., 2006; Abrudan et al., 2005). About 10.4% of the national forest area is included in the national and nature parks and 160,429 ha of forests are strictly protected.

50. 22 of Romania's national parks are managed by the National Forest Administration - Romsilva (NFA) (Abrudan et al., 2009). Many of the other protected areas, however, lack professional management, financing and scientific support. (Ioja et al., 2010 and Soran et al., 2000).

2.3 Institutional Dimensions

51. Over the past decade there have been significant institutional and organizational changes within the forest sector in Romania. The General Directorate for Policy, Strategies and Projects for Waters, Forestry and Fisheries (GDPSPWFF) now within the Ministry of Environment and Climate Change (MECC), under the delegate minister for Waters, Forestry and Fishery, is the public authority responsible for forests. During the past few years, the regulatory, supervisory and support functions have been contained in varying Directorates within the General Directorate. Under the Delegate Minister there also is a Directorate of Forests and Hunting dealing with most of the matters related to forestry. Under the same Delegate Minister there is a special Directorate in charge of law enforcement in the forest sector.

52. Forest Inspectorates were established in 1999. They are responsible for law enforcement and control in the forests. In 2001, the number of inspectorates was increased from seven territorial branches to 16 to assist with the increasing levels of restitution. In 2005, the inspectorates were reduced to nine branches partly because the amalgamation of separate hunting and forest branches.

2.3.1 Ownership of forests

53. Following the implementation of land reform legislation (Law no. 18/1991, Law no. 1/2000, Law no. 247/2005 and other laws amending and supplementing them, and of regulations, detailed procedures and associated laws), by 2009 66% of the wooded land areas were in the public domain while 34%

were privately owned. There are an estimated 850,000 forest owners in Romania. Private forest ownership in Romania spans both small and large, and individuals, indivisible communes, and churches.

54. The predominant ownership structure is characterized by relatively small holdings and fragmentation of the forest system (World Bank, 2011) - the Table 2 and 3 provide data on forest ownership in 2012.

Table 2: Forest Ownership 2012 (million ha) (source MECC, 2013)

Ownership	**Area**	**% Area**
Public property of the state	3.16	51
Public property of local communities	0.90	15
Private property of communes – indivisible	1.25	19
Private property of physical persons and legal entities (individuals, associations, schools, churches etc.).	1.21	15
Total	6.52	100

Table 3: Distribution of Forest Land (by Size) among private owners (without forests owned by local authorities) (source World Bank, 2011)

Ownership category	Number of owners	Total Area (million ha)
Forest < 10 ha	828,000	0.85
Forest > 10 ha	2,200	1.35
Totals	830,200	2.20

55. While forests have been restituted, what can be done on the private forests is still restricted by law. The fragmentation of forests as a result of the areas under private ownership underscore the importance of having in place effective incentives and support for private owners to meet the legal requirements and contribute to national obligations. Restitution also has implications for meeting the country's Natura 2000 obligations.

56. The distribution of forest ownership under the Natura 2000 protection network is the following: 64% of the forests in sites with communitarian importance (SCI) and are state owned and 36% is privately owned (756,600 ha). Based on data from the national research agency for the forest sector (ICAS) the distribution of forest ownership in 2007 on Natura 2000 sites was as follows:

- 64% - state owned forest – 1,343,125 ha;
- 15% - forest owned by municipalities – 305,510 ha;
- 3% - forest owned by the church, 57,543 ha;
- 10% owned by indivisible communes – 202,778 ha;
- 9% - private individuals – 190,744 ha.

57. An additional challenge with the current land ownership structure is that after the forest land restitution, private forests have been subject to relatively active trading. The trading is often recorded in different ways but seldom formally registered. Successions of forest land titles also have not been recorded systematically. This has resulted in several court cases, many of which are pending court rulings.

National Forest Administration - Romsilva

58. The National Forest Administration – Romsilva manages state forests for production and protection purposes. The NFA manages 22 national and nature parks. NFA also manages approximately 1.2 million ha of non-state forest. The NFA's responsibilities include forest and other land administration and management, providing public services, and serving as a public authority in some aspects. In addition, NFA is involved in a number of businesses and duties outside the forest sector (for instance horse breeding activity).

59. NFA's main source of funding comes from earnings it is authorized to retain from its revenue generating activities – principally timber sales. In 2008, 77% of the NFA income was generated by timber sales. NFA also generates revenue from non-timber forest products (NTFP) sales and fees from chalet rentals, hunting, and forest administration contracts. Harvested volume and timber sales decreased significantly in the last five years due to the forest restitution process and the diminished forest area managed by NFA. Despite the reduction of area of forest under its administration, NFA continues to be the main wood/biomass producer in Romania.

Private Forest Districts

60. The legal requirements for forest management resulted in the creation of Private Forest Districts (PFDs). PFDs manage much of the non-state forests (that belong to legal entities (towns, villages, associations, church, companies etc.) and individuals) that are not managed by NFA. In 2011, 132 PFDs were managing 1.529 million ha of non-state forest (Abrudan, 2012).[4] The PFDs have their own national umbrella association – Association of Forest Administrators from Romania (www.ocoaleprivate.ro), which represents and lobbies for PFDs in national and international level.

61. These entities could play a significant role on the local/regional wood/biomass market. The PFDs' harvested volume was in excess of 5.89 million m^3 in 2010, approximately one third of the total harvested wood at the country level (Abrudan, 2012).

Forest Associations

62. There are several regional/local forest owner associations as well as a national umbrella association – such as the Romanian Forest Owners Association – APPR (www.appr.org.ro). Their role in forest sector market, however, is limited. By law, private forest owners are the legal entities selling wood

[4] A large part of the forests under management of PFDs are located in mountainous and hilly regions. Accordingly, the species composition of the area included European beech (37%), oaks (11%), other broadleaves (12%), and coniferous forests (40%), composed mostly of Norway spruce (32%) and silver fir (5%).

(i.e., selling most of their allowable cut on a competitive basis using auctions) to the customers (logging companies or other clients). In mid-2010 the large private forest owners from Romania (especially private investors which bought forest land from individuals) established their own association – Proforest – The Association of the Large Forest Owners from Romania. This Association intends to play an important lobbying and commercial role in the Romanian forestry sector.

2.4 Economic Contribution of the Forest Sector

63. Over the past years, the forest sector, including industry, has contributed between 2.2% and 4.5% to Gross Domestic Product (GDP) (Abrudan et al, 2009, FAO, 2012). In 2006, the sawmilling sector contributed 3.5 percent of GDP and made up 6 percent of manufacturing sector output (EBRD and MARD, 2007). In 2009, the furniture manufacturing sector represented 1.6% of the Romanian GDP and in 2010 (FRD Center, 2011). According to the Romanian Center for Trade and Investment, the share of furniture export in the total Romanian exports was 3.86 percent in 2009 and 3.45 percent in 2010 (FRD Center, 2011). In 2010, the forest sector and wood industry contributed 3.5% of GDP (source INS-CON105D) compared to 13.5% from agriculture and food industry. In 2011, the percentage of national exports from the forest sector was 7% (compared to 10% from agriculture sector and food industry).

2.4.1 Wood Industry

64. Romania is known globally for its wood products. Wood products in Romania include sawnwood, lumber, pulp and paper, panel and veneer and furniture. There is a longstanding tradition of producting solid wood furniture, some of which are specialized furniture for foreign markets. Local manufacturers are actively involved in the sector. There also are several domestic and foreign investors in Romania. The latter include investors from Spain, Italy, Germany, Austria and Sweden. (FRD Center, 2011). In 2011, there were 12,537 companies (compared to 20,882 in the agriculture sector and food industry) (INS, 2011). The primary wood processing industry, excluding furniture production, has about 7,500 operational companies. The Romanian furniture market is made up of about 4,000 companies of which only 100 are big companies. The majority of the companies are small and medium-sized enterprises (SMEs) (FRD Center, 2011). This sector is especially attractive for small entrepreneurs, and approximately 92 percent of all wood processing companies are SMEs.

65. Estimates indicate that the domestic furniture market, with a value of almost €1 billion business per year, registered a 15-20% decline in 2010. This was mainly due to the increase of the value added tax (VAT). At same time, the exports of furniture registered the highest figures in history in 2010. (FRD Center, 2011).

Employment

66. The forestry sector is an important employer, especially in rural areas. The numbers, however, have dropped from 235,000 in 2000 to an estimated 142,676 formally employed in 2011 (compared to

285,491 in the agriculture sector and food industry in 2011). In 2008, there were an estimated 3,500 furniture plants and workshops employing about 80,000 people. The average total number of staff under NFA management was 20,905 at the beginning of 2009.

Geographic location of forest industry

67. The most timber-rich regions of Romania are the Northeast, Northwest/West, East, and Southwest. The Romanian wood furniture production relies mainly on solid wood, plywood, wood panels, medium density fiberboard, and wood veneer. The Northeast is the largest supply source for coniferous species such as pine, fir, and spruce. It has a well-established industry with large capacity in both timber harvesting and wood processing. Non-coniferous species are more important in the Northwest/West and East (oak and cherry) and Southwest (beech). Among these three regions, demand tends to be greater in the Northwest/West, due to high export demand from neighboring western countries. Demand in the Southwest, which includes only the Caras Severin forest directorate, is very weak despite the good quality of the region's beech stands.[5]

68. The Central region and the South have strong demand but poor supply. Factories in these regions rely on timber harvested elsewhere. The Central region has the biggest investment in wood processing in Romania, but it also has the smallest area of public forest in the country, and forest ownership is divided among numerous small owners due to restitution. This depresses demand for timber from local sources because mills prefer to deal with large, stable suppliers. The Danube region (counties of Bucuresti, Constanta, Dolj, Ialomita, Mehedinti, Olt,Tulcea) has a substantial supply of poplar trees. There is some export demand for poplar wood, but the demand is not consistent.

Challenges for economic contribution of the sector

69. Most analyses highlight a significant potential for the wood sector in Romania whether it is in manufacturing or biomass energy. The sector, however, is also importing wood despite the available supply in the country. A few reasons why there is a decline in the wood processing industry include:

- Poor accessibility: The average road density is 6.4 m/ha (and decreasing due to lack of funds for rehabilitation).[6] This results in a more than 2 million ha of forests being practically out of reach for technical and economic reasons (World Bank, 2011). Poor accessibility also has implications for management of the forest stands independent of the management objective;
- Outdated technology: technologies continue to be outdated and production processes are inefficient for many firms in the Romanian forest sector. This is especially true for timber harvesting companies. Inefficient technologies also reduce the amount firms can pay for a cubic meter of standing timber;

[5] This region is lightly populated and has high wage rates, due to a large mining industry and commercial trading opportunities with neighboring Serbia. The tight labor market has discouraged the development of local timber harvesting and wood processing industries.

[6] This is significantly below other European countries with similar topography (Austria 36m/ha, Switzerland 40m/ha, France 26m/ha, Germany 45 m/ha). (World Bank, 2011)

- Weak forest associations: Given the number of smallholders involved in the sector, economies of scale are hard to achieve unless there are well functioning associations. Due to historical reasons, small holders have been apprehensive to engage in associations. This, however, is changing. There increasingly are examples of successful associations in the country;
- There has been limited exploration of biomass production plantations in the context of a increasing emphasis on other renewable sources of energy, especially in Europe more broadly; and
- Limited training in the arena of climate change and coordinated research

70. As a result Romania suffers from overcapacity in the primary wood processing sector. This, however, has lessened in recent years (World Bank, 2011).

2.4.2 Biomass energy

71. The biomass potential or Romania is estimated at 88,000 GWh per year. In 2004, about 43% of the biomass potential in the country was exploited. The entirety of that biomass potential went to the production of heat. Heat generated from wood biomass was approximately 54 percent, and heat generated by agricultural biomass was about 46% (BERD, 2011). Large amounts of small-sized wood is obtained in wood industry, but utilization of this wood for energy purposes is insufficient due to difficulties related to gathering, processing and transportation. Firewood and agricultural waste account for about 80% of the total waste. About 66% of the firewood and wood waste is located in the Carpathians and Sub-Carpathians, and about 58% of agricultural waste is located in the South Plain, West Plain, and Moldavia (BERD, 2011). However, recent studies show that these wood wastes are economically viable resources. (BERD, 2011)

2.5 Afforestation

72. Existing degraded lands and lands with limited agricultural potential offer opportunities for afforestation in Romania. Areas of agricultural land that are subject to several limiting factors because of adverse meteorological and climatic factors such as drought, flooding, erosion or landslides, low humus reserves or low supplies of key soil nutrients are considered lands with limited potential. Every year, such tracts of agricultural land become classified as being of "lowest suitability" in spite of measures taken to ameliorate the agricultural potential of the area (e.g., irrigation, land reclamation and use of fertilizers)[7]. There are an estimated 2 million ha of such agricultural land every year. 700,000 ha of this area was arable land and 1.2-1.3 million ha are pastures and hayfields. (Bohateret, 2012)

[7] Agricultural land scoring below 25 points in soil quality assessments is neither of economic interest for agriculture, nor attractive for businesses, because production costs far exceed any potential agricultural yields. Agriculture practiced under such adverse conditions would impoverish the population using agricultural produce for own consumption and also cause further fragmentation of agriculture (Bohateret, 2012)

2.5.1 Afforestation of degraded lands

73. Initial results of Ministry of Agriculture and Rural Development (MARD, 2012) study on degraded lands reveals a clear correlation between land areas subject to aridity (under the HADCM3 scenario) and surfaces with limited forest cover (Figure E, F, and G below[8]). MARD also conducted an inventory of degraded lands (for 16 out of the 41 counties) to design the national program for restoring degraded lands. The inventory found that 836,475 ha are degraded, out of which, approximately 115,129 ha are suitable for improvement through afforestation (MARD, 2012).

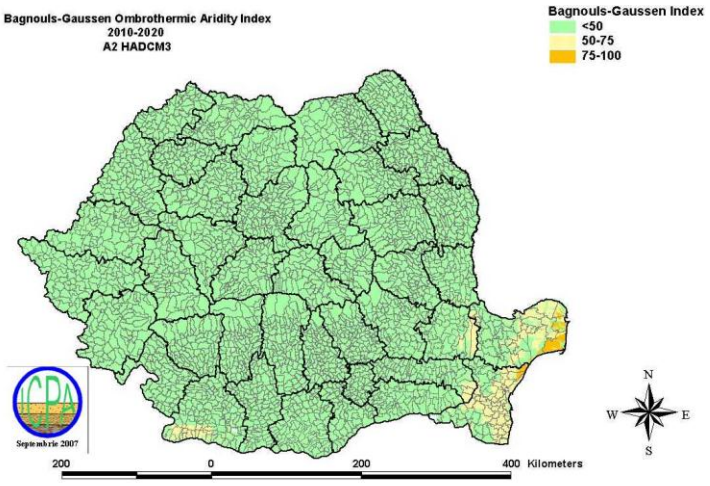


Figure E: Aridity index BGI average for 2011-2020 (HADCM3 global scenario – ICPA, 2007)

[8] The Bagnouls-Gaussen Index is used to estimate the aridity index which is important because it is a critical environmental factor affecting the evolution of natural vegetation and therefore rain erosivity by consider rainfall and temperature.

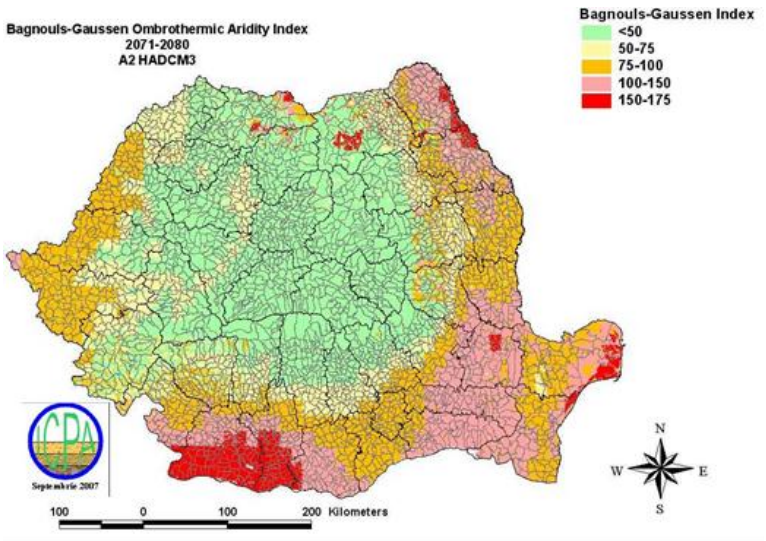


Figure F: Aridity index BGI average for 2070-2080 (HADCM3 global scenario – ICPA, 2007)

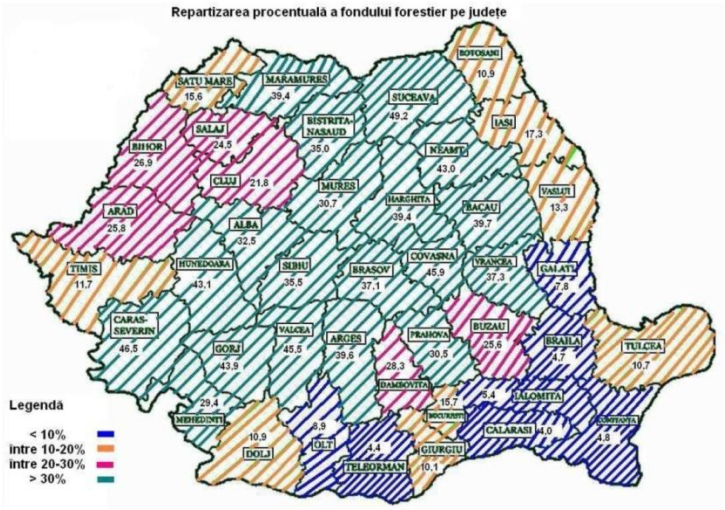


Figure G: Forest on counties (%) (Source: National Programme for Afforestation, 2012)

2.6 Data collection in the forest sector

74. A National Forest Inventory (NFI) is essential for information on the resource base. In 2008, Romania launched the field data collection activities associated with a NFI[9]. By the end of 2010 approximately 65% of the required field data encompassing 28,000 forest plots had been collected. Once completed, the NFI will provide information on (a) current values and rate of changes on quantity and quality of

[9] The last NFI was in 1986.

forest resources, (b) spatial distribution of forestlands including ownership, (c) forest biodiversity and carbon pools and (d) estimates of future growth (World Bank, 2011). Initial findings indicate that land under forests has increased (although no specific quantitative values have been provided).

75. The forest sector of Romania has relatively well established research capacity. Forestry research is undertaken by three main entities– the forest faculties in universities, NFA and ICAS. ICAS has research sites, and researchers who examine wide ranging issues in the sector, spanning from policy research to the impact of changes in forest conditions on forest growth, pest outbreaks, and pioneering work on understanding impact of climate change on forests and measures needed to enhance their resilience.

76. Universities in Romania conduct both *ex ante* and *ex post* modeling and predictive modeling. Universities have also been active in downscaling climate change models and examining the impact of policy and institutional changes on forest resources (for example, the impact of restitution on CO2 removal in forests). NFA compiles and analyzes data from the public and private forests they manage to inform future activities.

2.7 New Forest Strategy

77. In November 2012, the Delegate Ministry of Forests started the process of elaborating the new Forest Development Strategy for a 10 years period. A draft strategy was produced in June 2013 and final consultations are expected to be completed in 2013. The draft strategy envisages a role for forests in climate change mitigation and highlights necessary measures for adapting forests. These measures include:

- Increasing forest coverage by afforestation of degraded land;
- Developing new scientifically sound methodology for compensating private forest owners;
- Developing new technical guidance for forest management that reflects climate change adaptation;
- Creating National Forestry Body to supervise and monitor forestry;
- Increasing the accessibility of forests;
- Increasing investments in watershed management.

78. An area where the strategy could be further improved is by taking into account economic aspects of the sector. This would facilitate developing a realistic prioritization and also putting in place market and non-market incentives for achieving the objectives of the strategy.

3. CLIMATE CHANGE AND FORESTS

79. Climate change projections indicate that at the country level there will be a 2^{o}C increase in average winter temperatures and over 3^{o}C increase in average summer temperatures. The areas outside the Carpathian arch, in particular, will experience higher temperatures in winter, while the South and Southeast will experience higher temperatures in summer. Climate models also predict an increased frequency of extreme meteorological events.

80. Precipitations are expected to be more abundant across short periods of time, and across smaller areas, leading to more frequent flash floods, and also to more intense drought periods. While the regime of precipitations may not change significantly in the winter[10], there will be an overall decrease in precipitations in the summer[11]. The average daily rate of precipitations for Romania will decrease by about 20%. However, the predictability of precipitation will vary greatly across regions, especially in Eastern Romania. (MECC, 2012). Together with the floods, the long periods of drought cause important economic losses in agriculture, transports and supply of energy, water management, health and households.

81. The area affected by aridity in Romania has increased in the last decades. The Southeast has been most exposed to drought. In the years 2000 and 2007, almost the entire territory of the country was affected by an extended drought. Romania has a national strategy for combating drought, land degradation and desertification which includes short, medium and long term actions and measures to mitigate effects of drought, and to combat desertification and land degradation. Activities included planting of trees to reduce soil erosion and restore degraded lands.

3.1 Forests and GHGs Removals and Emissions

82. Forests are important for sequestering GHGs and reducing emissions, thus mitigating climate change. CO2 is one of the nutrients that are necessary to build the organic chemicals that are part of leaves, roots, and stems. All parts of a tree contain carbon, although the proportion of carbon depends on the species, age, and growth pattern. Nonetheless, as plants grow, more CO2 is converted into biomass, reducing the carbon in the atmosphere and storing it in the vegetative matter above and below ground. Carbon is also sequestered in forest soils. The amount of carbon in the soil varies depending on the environment and history of the site. The carbon that is removed can be released back into the atmosphere when the vegetation dies, for example because of a fire or through gradual degradation and decomposition.

83. The Kyoto Protocol allows certain removals of carbon by a nation's forests and soils—"carbon sinks"- to be counted and deducted from emissions. On average, temperate forests, such as those

[10] The exception will be a slight increases in the Northwest and slight decreases in the Southwest

[11] The decrease will be up to 40%, especially in the South and Southeast

found in Romania store approximately 168 tC/ha (Gorte, 2009). The vegetation of these forest system store more than one-third. The remainder is stored largely in the soil.[12]

84. Romania's GHG Inventory (National Inventory Report) from 1989 to 2011 stated that "[i]n 2011, the GHG emissions without [land use, land use change, and forests (LULUCF)] have decreased [by] 54.9% comparing with the base year level." When factoring in LULUCF, "the net GHG emissions/removals (taking into account the carbon dioxide (CO2) removals) decreased [by] 61.1 %." (MECC, 2013). The detailed reporting of GHG emissions and removals from LULUCF[13] reveals the significant contribution of forest land remaining forest land in sequestering GHGs (or "removals" of GHG), as show in Table 4.

Table 4: Net GHGs emissions for the LULUCF Sector in 1989, 2010 and 2011 (source MECC, 2013)

IPCC subcategories	Emissions (+) / Removals (-) in Gg CO2eq		
	(BY) 1989	2010	2011
5A1. Forestland[14] remaining Forestland	-18863	-22263	-20384
5A2. Land converted to Forestland	-122	-2498	-3061
5B1. Cropland[15] remaining Cropland	-5784	-2336	-3223
5B2. Land converted to Cropland	-17	18	20
5C1. Grassland remaining Grassland	NO	NO	NO
5C2. Land converted to Grassland	-654	130	118
5D1. Wetlands remaining Wetlands	NO	NO	NO
5D2. Land converted to Wetlands	-215	-126	-130
5E1. Settlements remaining Settlements	NO	NO	NO
5E2. Land converted to Settlements	4125	419	410

[12] The higher proportion of carbon in the temperate forest soils compared to vegetation is because of slower decomposition rates.

[13] Estimating emissions and removals of GHG from LULUCF follows the Guidelines 1996 methodology presented in Good Practice Guidance for LULUCF, IPCC, 2003 (MECC, 2013)

[14] This category includes: forest lands or those that serve the culture, production or administration of forest, lands for afforestation and unproductive lands comprising rocks, steep and stony slopes, ravines, gullies, torrents, if they are included in forestry planning (for better understanding of forest vegetation issue please check the section 5A1 Forestland and descriptions of other land categories, i.e. Grassland). (MECC, 2013)

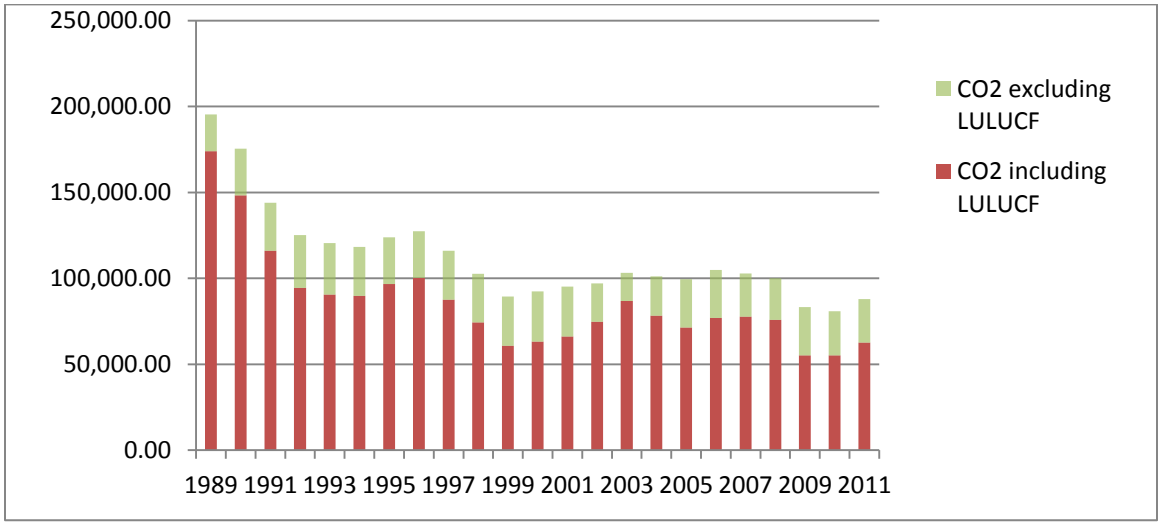
[15] This category includes: arable land, vineyards, orchards, vineyards and orchards, nurseries, hops and mulberry trees, pastures, hayfields, greenhouses, solariums, greenhouses, the land covered with forest vegetation if it is not part of forest fund, wooded pastures, land occupied with agro-zoo-technical constructions and land improvements, fishery facilities, roads and technological storage

5F1. Other land remaining Other Land	NO	NO	NO
5F2. Land converted to Other Land	-30	789	835

Source: MECC (2013)

85. The total GHG emissions in 2011, excluding removals by sinks, amounted to 123,345.54 Gg CO2 equivalents (MECC, 2013). CO2 emissions from LULUCF (as shown in Figure 2) are largely from land conversion. Since 1999, there is a reduction in total CO2 emissions by approximately 30% on average every year when LULUCF is taken into account (see Figure 2). When examining the change in emissions compared to the base year, **LULUCF constitutes approximately 10% of the total reduction in emissions**.

Figure 2 – Difference between CO2 emissions including and excluding LULUCF (Gg Tonnes)



86. To use forests to mitigate climate change will require putting in place conditions that help reduce CO2 emissions and sequester carbon. This includes conditions for planting more trees (through afforestation or reforestation) and maintaining the health and resilience of forests (through sustainable forest management)

3.2 Impact of Climate Change on Forests

87. Forests, like other natural systems, are affected by climate change. The effects of climate change on forests can reduce the contribution of forests to mitigating climate change, as many of the impacts of climate change decrease the growth rate of forests and cause degradation of forest areas. Climate change causes and, in some cases, compounds biological risks to forests. Climate change also can accelerate degradation of forests and increasing incidence of fires, both of which result in emissions of CO2. This subsection describes some of the impacts of climate change and climate variability on Romania forests based on existing studies.

Impact of change in precipitation and temperature

88. Projected changes in precipitation and temperature in Romania are anticipated to primarily weaken existing forest systems and decrease growth. ICAS models predict a decline in growth by 30%. This dramatic decrease in growth is likely to occur for forests in the plain areas (ICAS, 2005). In Romania, approximately 1 million m^3 of timber are lost annually to wind and snow, and approximately 130,000 ha of the designated forest areas in the lowland are annually affected by drying due to soil water deficit. Compounding these losses are the damages caused by insect attacks. During the period of 1990-2006, forest health monitoring in Romania indicates that the forest health was poor in 1991, 2005, and 2006. The country had moderately disturbed forests in 1990, 1992, 1995-1999, 2000-2004.

89. Romania has limited research on the impact of climate change on forests. The few studies that are available indicate that in the Hills of North East Romania, severe droughts (during the period of 1999-2000) triggered the drying of beech stands in some old (> 100 years), (almost) pure, and highly productive stands, situated in flat areas with clay soils and on small slopes with shallow or sandy soils. The drought has also been associated with pests and infestation of the wood. Drought is thought to have had the same impact on silver fir and caused a similar decline (Chira et al., year unknown). In the plains, where the forests have also been subject to severe droughts, there is limited limited research on how drought has influenced species distribution, productivity, and protection due to the low forest cover.

90. Survival of woody species is constrained by water availability. Prolonged drought during vegetation season may induce episodes of large-scale tree decline (Bréda et al. 2006 as cited by Trombik et al., 2013). ICAS (2003) found from expert inputs that drought and change of the local hydrological regime lead to difficulties in natural regeneration of forest species.

Change in species composition and extent of forests

91. The shift in suitable ecozones for species has implications for any future efforts that involve the planting of trees. When tree species are planted outside of their natural areas they are more susceptible to negative biotic factors – pests, water stress, and so on (see section below on pest infestations). In the mountains, forests are invading pastures. The process is driven by pioneer species but also species such as Norway spruce. In the southern part of the country, nonnative species are invading natural forests -- for example *Rosa canina* and black locust (*Robinia pseudacacia*). Non-native species are also invading natural forests in the plains region.

92. Trombik et al., (2013) used an ensemble of climate change scenarios to assess how climate change would affect the distribution of certain species in the Carpathians. They found that the projected changes in temperature and precipitation in the Carpathians would cause species such as Beech to lose their competitive vigor in the Outer Eastern Carpathians that fall within Romania's boundaries. Beech mortality was likely to occur in in the Transylvanian Plateau, where beech occurs marginally. Climatic conditions for beech are projected to worsen substantially in the distant future. Conditions that result in beech mortality may occur in large areas of beech stands in Romania. While multiple climate models predict the decline of beech, there is greater uncertainty in the models predicting

beech mortality. The other occurrence is that trees in mountains are invading pastures, specially the Norway spruce.

93. In protected areas, climate change is also expected to cause migration of species to areas with more favorable temperature and precipitation. Studies indicate that competing invasive species that are often more adapted to the new climate will move in, modifying the ecosystem. The occurrence of such movement could leave modify the habitat and species assemblage in certain protected areas, rather than preserving the systems they were initially designed to protect.

Increase in pest infestations

94. One of the main pests is the bark beetle. There has been an increase in outbreaks of the bark beetle in Europe at higher altitudes and latitudes, where there are favorable temperature conditions (Hlásny & Turčáni, 2009). New pest species have been reported while some of existing species have become more aggressive. The pests are affecting economically valuable species such as maple, spruce stands (outside their natural area), alder, ash, black locusts, and oak. This can have a major impact on the stability of forest ecosystems (Lange et al, 2006), and can increase the forest area affected and the number of trees killed, increasing the likelihood of CO2 emissions. Also, it is possible that bark beetles are going to become more resistant to treatment at higher altitudes and higher latitudes.

95. *Ips duplicatus*, another bark beetle, initially recorded 1948, is currently present in almost all forests of Romania that have Norway spruce and are situated at below 1000 m altitude (Duduman et al, 2011a). The number of attacked trees significantly increased after 2002-2004, reaching a level of 50,000 infested trees per year in 2007-2009 (Olenici et al., 2011). Approximately 47,000 m^3 of trees were infested by the beetle during the period 2002-2009 (Olenici et al., 2011). In August 2012 reports indicated that over 100,000 trees had been infested during the current growing season. The attacks only manifest in Spruce stands at altitudes below their natural distributional area, after episodes of drought in the area, and in very dense stands which cannot be thinned due to the potential of windfalls.

Drying of stands and species

96. ICAS (2003) found poplar and willow drying in the meadows (even where there are investments to provide adequate water). Drying phenomenon in oaks has been reported with a higher frequency than in the previous decade. Drying of black locust stands also is occurring in the south and east part of the country. There have been drying phenomena reported in oaks during several time periods[16] .The latest wave of oak drying in Romania also impacted species that are considered to be resistant to the phenomena: *Quercus frainetto*. A study on beech found that average defoliation increased from 29% to 42% once the damaging effect of the drying phenomena occurred between 2001 to 2004 (Chira et al., 2005).

[16] The periods included: 1910-1914, 1937-1943, 1947-1949, 1955-1961, 1980-1990

Changing stands productivity (decrease in the annual increment)

97. Different growth scenarios (JABOWA III), based on climate change scenarios developed by the National Institute for Meteorology (INM), show up to 30% reduction of trees population and a decrease in growth, especially for forests in the plain areas (ICAS, 2005). Badea and Neagu (2010) found that there were different average annual growth in volume among different tree species in Romania that could be explained by the conditions of vegetation, climate and site. They also found that for healthy trees there were higher values of annual growth in volumes than the more damaged trees. The difference ranged from 0.09m^3/yr/ha for Oak and 6.44m^3/yr/ha for beech. The value of volume of growth loss (%) due to damage was between 1-12% for the 10 year period. If it was assumed that between 90-100% of trees are damaged by the biotic and abiotic factors, mean growth loss would increase to 40- 45% (Badea and Neagu, 2010).

Forest fires

98. A recent report from the General Inspectorate of Emergency Control states that statistics on fire incidences shows that forest fires have not been a high risk in Romania. Anthropogenic factors and changing climatic conditions, however, could increase the incidence of fires. From the analysis of the causes, results unequivocally show that fires with natural and accidental causes represent about 2% of all forest fires. Anthropogenic causes, after restitution of forest lands, are more significant. In 2012, burning vegetation on pastures was the main cause of forest fires (572 fires on approximately 4,397 hectares); most of the forest fires were located in the forests near pastures in plane and hill areas. During the next five years, climate change will affect southern and eastern Romania, and these areas will be exposed to forest fires due to a higher temperatures and decreased precipitation. The estimated annual cost is € 200,000.

Impact on biodiversity

99. Climate change might be a threat for Romanian biodiversity in the following ways (2):

- modifications of the species behavior, as a result of the stress induced on their adaptation capacity[17];
- modification of the habitats distribution and composition as a result of the change in the species structure;
- increase of the exotic species at the level of the actual natural habitats and the increase of their potential to become invasive;
- modification of the distribution of the ecosystems specific to wet areas, with the possible limitation up to their extinction;
- changes in the freshwater and marine aquatic ecosystems generated by water warming and sea level rise;
- extinction of certain flora and fauna species.

[17] The adaptation capacity could include shorter hibernation period, the modification of the behavioral physiology of the animals as a result of the hydric and thermal stress or the stress by solar radiation; the impossibility to provide the transpiration conditions at normal physiological levels, negative irreversible influences on the migratory species, disturbance of plants evapotranspiration, essential changes in the plants rhizosphere which may lead to their extinction.

(Source: http://www.climateadaptation.eu/romania/biodiversity/ (viewed, 2013))

100. Research shows that species interaction (e.g., between predator and prey species or insect and host plant species) are important for their survival at a particular point and could also affect their range. The latter is true when co-occurring species do not necessarily react in a similar manner to global change, having important consequences at ecological and evolutionary time scales (Schweiger et al., 2008 - http://www.esajournals.org/doi/abs/10.1890/07-1748.1).

3.3 Adapting Forests to Climate Change

101. In the face of climate change, forest managers need to choose the appropriate management approaches for maintaining and increasing ecosystem services from forests. Reduction of the vulnerability of forest ecosystems requires reducing exposure of forests to climate change and decreasing their sensitivity to changes in climate. The former can entail management practices that include controlled burning, reducing forest fuel loads, and preparing for extreme weather conditions. The latter can require planting hardier species or reducing water stress. Management practices such as reduced impact logging or thinning of overstocked stands can also increase the resilience of forests. These measures can be implemented through sustainable forest management.

102. Adaptation measures should be based on scientific research and technological advances which support the sustainable development of forests, taking into account the environmental and socio-economic context. These measures must also be accompanied by adequate monitoring of the health of forests, as well as of their development. Currently there is limited information on the adaptation requirements for Romania's forests.

103. There is need for quantifying the effect of climate change (including extreme events) on forests and assess potential damages. Such as assessment will require technical inputs and monitoring capacities which currently are limited in Romania. Depending on findings from such an assessment, suitable measures can be identified. A potential adaptation measure would be to intensify reforestation. This would assist in maintaining the forest ecosystems while offering cobenefits such as reduced soil erosion, preventing landslides and diminished flooding. These measures would also be favourable for tourism in Romania. Forests should be populated with less vulnerable species of trees (for example, beech in low mountain areas). Climate-proof species of trees should also be resistant to new types of pests.

3.4 Forests and Adaptation to Climate Change

104. Forests are important in ecosystem-based adaptation strategies for other sectors, such as agriculture (see Figure 3). The impacts of climate change (in the medium and long term) also point to the need to adapt forests to climate change.

Figure 3: Forests for Adaptation, Adaptation for Forests

Source: Locatelli, 2011.

105. Studies by the Economics of Ecosystems and Biodiversity (TEEB) illustrate the economic benefits from ecosystem based adaptation including using forests for adaptation. Operationalization of this concept is increasing, although additional research is needed to better understand adaptation benefits. Examples from countries such as Germany, UK, and Belgium point to clear ecosystem benefits but offer less discussion on adaptation.

106. In Romania, forests provide ecosystem benefits for agricultural landscapes. Ivan (2012) identified forest belts as providing climate resilience benefits in agricultural systems. These benefits include:

- Improved microclimatic conditions of growth for protection development of agricultural crops up to a distance 25 times the height of belt in the sheltered and 5 times in the exposed area, due to the reduction of wind speed by 31-55% in the sheltered area and 10-15% in the exposed one
- Reduced spread of diurnal air temperature in cropping area with 1-40C and the annual one with 1-20C
- Increased humidity and level of ionization of air at soil level which enhances soil fertility and pH
- Reduced the depth and duration of freezing, and decreased evapotranspiration
- Sequestered GHGs – it is estimated to sequester 40 tCO2e/ha/year of carbon dioxide

107. Ivan (2012) found that forest belts offer the greatest protection for agricultural crops when the primary species used reach a height of 15-20m. Extra protection and increased biodiversity result when the forest belts include secondary species at heights between 6-10m and shrubs at 1-5m in height. Benefits from forest belts are highest around age 10, but farmers can also avail of benefits throughout the time they are being established.

108. Agricultural crops suitable for cultivation with forest belts include cereals, soybean, sunflower, vegetables, meslin, other fodder species and horticulture crops. Albu Anca et al (2010) found that due to decreased evapotranspiration, cereal production in the area protected by shelter belts was higher by about 20%, even if the forest belt reduces area under agriculture. This finding confirms results by Nesu (1999) that in the plains and agricultural area, forest belt 15 m high increased production in various crops - 17% in wheat, 13% in green alfalfa, 12% in soy bean. In addition to increased

productivity of agricultural crops, forest belts can also protect roads and railways adjacent to the belts because they diminish the damage done by extreme winter snows.

109. In 1986, forest bests covered approximately 9,300 ha of agricultural land. In 2009, this area declined to approximately 1,400 ha. Forest belts are known to have a positive effect on agricultural production.

4. OUTCOME OF DIFFERENT FOREST MANAGEMENT SCENARIOS ON GHG EMISSIONS

110. Forest management approaches influence the net GHG emissions from the sector because of its influence on growth, extraction and health of the forest. . There are different models and approaches for assessing the outcome of future scenarios. This section presents outcomes from national modelling efforts and compares the findings with international models and outcomes.

4.1 Outcomes from National Modeling Efforts

111. The Joint Research Center of the European Commission (JRC) and ICAS in 2012 conducted a set of studies that stimulated the dynamics of carbon stocks in forest ecosystems in accordance with the Kyoto Protocol (that is considering above and below ground carbon from biomass, litter, dead wood and organic carbon stored in soils) to examine various scenario of forest resource management. The first study, conducted by JRC, does a sensitivity analysis of 20% on the business as usual scenario.[18]

112. Under the business as usual scenario and the assumptions used in the JRC modeling, it is expected that large areas of forest will move from middle-age classes (21-40 and 41-60) to pre-harvesting and harvesting age classes (61-80, 81-100 and above 101), and the area of higher age classes will increase. The shift of trees to older age classes will also mean decreased CO2 sequestration. Under the present forest management norms, therefore, there will be a slow decrease of the carbon sink for the period 2013-2020. The study states that an abrupt decrease in carbon sink (during the period 2013-2020) could happen if the following occurred:

- Revision of the regulations that dictate forest management planning and harvesting wood (these are hereafter referred to as technical norms)
- Large-scale investment in forest infrastructure
- Large scale natural disturbances which may imply larger concentrated cuttings in some years

113. The JRC model was calibrated using historical data and the average emissions and removals from forest management were estimated (see Table 5). Projections revealed that significant forest areas will leave the middle-age classes and enter the pre-harvesting and harvesting classes, increasing the area under the higher age classes. This will cause a reduction in the sink of Romanian forests (because growth, and therefore carbon sequestration, decreases with age). As the timeframe for the projections are extended out (which is justified given the harvesting age of some of the natural species), the difference between the average emissions per year decreases. (JRC, 2012)

[18] The JRC study uses G4M (from the International Institute for Applied Systems Analysis) and European Forest Information Scenario Model (EFISCEN) (from the European Forest Institute, EFI) were used to project emission and removals from forest management. The economic demand was projected using Global Biosphere Management Model (GLOBIOM) and PRIMES biomass model. One of the assumptions is that all forests are under management.

Table 5: Emissions and removals from forest management as estimated by JRC modeling

Scenario	Average emissions 2013-2020 (Gg CO2e)
Business as usual (calibrated average of models)	-28044
+ 20% harvest level (sensitivity analysis)	-25099
-20% harvest level (sensitivity analysis)	-31142

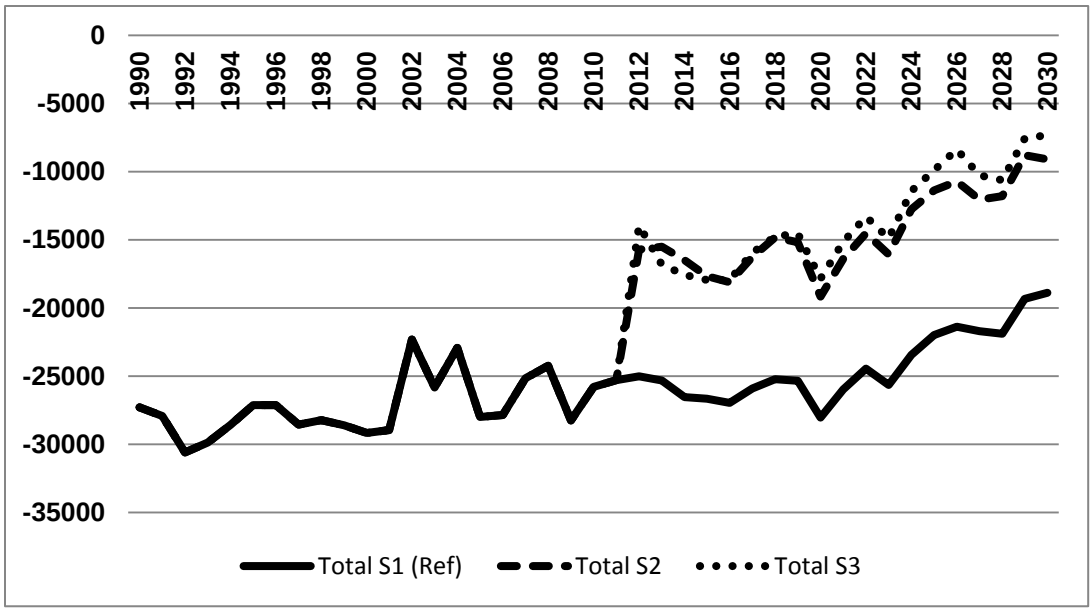
114. The second study, let by ICAS, examines GHG projections for 2015-2030 under three scenarios –

- Scenario 1 (S1): assumes the current practices of resource management for all types of lands. This scenario also includes afforestation of 2000 ha annually. The estimate is based on an average between maximum and minimum values in consecutive years.
- Scenario 2 (S2): measures to improve land use (by increasing annual harvest of wood to the pre-1989 levels (when there was excessive logging and allowable annual extraction levels were constantly exceeded by 15-30% (Bohateret, 2012), afforesting degraded lands at 5000ha/year (this will include re-vegetation and forest belts (from 2012-2030) and implementing 'no-till' practices for 30% of the arable land in rotation per year, and
- Scenario 3 (S3): measures to improve land use and additional financial incentives for specific public good services (This will include measures to increase annual harvest of wood to pre-1989 levels through intensification of forest management, afforestation of degraded lands at a rate of 10,000ha annually (including re-vegetation and forest belts), creation of woody biomass from fast growing crops (at a rate of 5000ha/year), implementation of "no-till" practices for 40% of the area of arable land (in rotation) per year from 2015 to 2030, and increasing the protected area of nature conservation and biodiversity protection).

115. This study concludes that for the timeframe considered (2015-2030) the quantity of CO2 removals is highest under S1 (i.e., has a greater negative value). In contrast, under S2 and S3 less CO2 is removed each year, so the value is a lower negative value[19] (see Figure 4).

[19] Both this and the previous model relied on 1985 NFI data and the experts had concerns regarding the accuracy of the CO2 emission removal estimates. The new data from the new inventory was not used as the inventory is yet to be completed. Furthermore, the modelling of GHG emissions requires the second cycle of measurements to obtain the increment values.

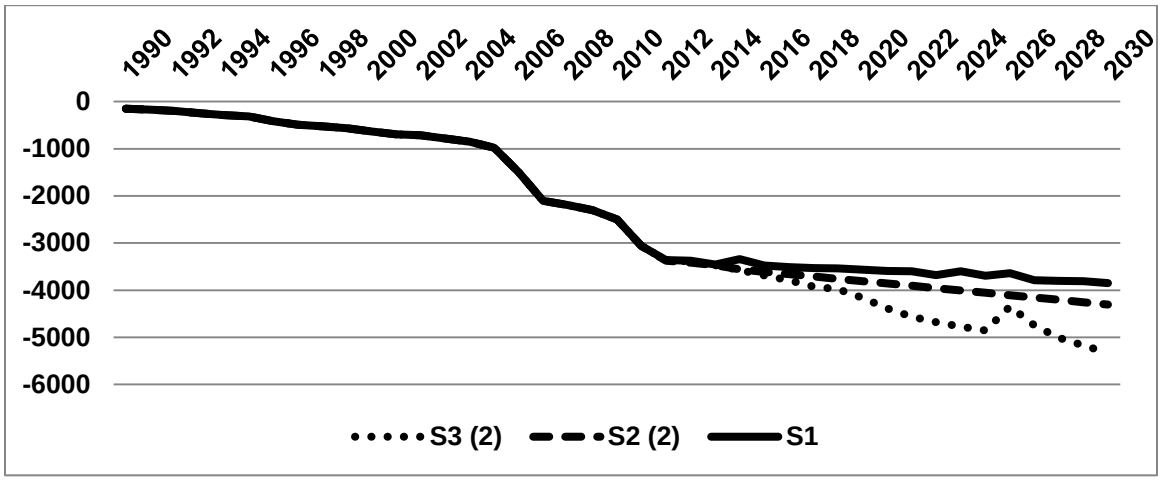
Figure 4: Graphical representation of modeling results (y-axis is Gg CO2e) – source ICAS



116. A decrease in level of CO2 removed is characteristic under all three scenarios. The decrease, however, is lowest under S1 (i.e., the reduction in the value of the negative number is lowest). The cause for the decrease in S1 is the aging of the uncut forests which sequester CO2 at a slower rate, and the young stock replacing the cut stands initially have a low CO2 absorption. S2 and S3 result in lower levels of CO2 removal due to the assumption that the harvesting quantities will increase in subsequent years to the level of harvesting before 1989. Experts indicated that as the young trees mature, an increase in CO2 removal will occur when the stands are approximately 40 Years – around 2050-2060. The annual amount of CO2 removals for S2 and S3 would then increase in comparison to S1.

117. The ICAS model also adds conversion of land to forest land (through afforestation) to each of the three scenarios. Afforestation would lead to a higher annual amount of CO2 removal. In S2 and S3, the increase would be 10% and 25% respectively compared to S1 (see Figure 5).

Figure 5: Graphical representation of the removals of CO2 by lands converted to forestland in the three scenarios (Y-Axis is in Gg CO2e)



118. In summary, the ICAS model and the JCA model predict that maintaining the current scenario is a preferred objective in the near term. The conclusion is counterintuitive when examining the potential for CO2 removal in young forest stands (discussed below).

4.2 Comparison of National Models with International Scenarios

119. Analysis in Nabuurs et al. (2007) and growth curves in Kinderman et al. (2013) indicate that intensive management of forests and increasing sustainable harvesting of timber can increase the level of CO2 sequestered compared to maintaining forest stands (see Figure 6 and Figure 7). The general evidence is that if forests are not thinned and remain un-managed, then the more mature trees, as their growth slows, over-shade and suppress the younger more vigorous stems.

Figure 6: Growth curves for central region of Europe with Picus model (Kinderman et al., 2013)

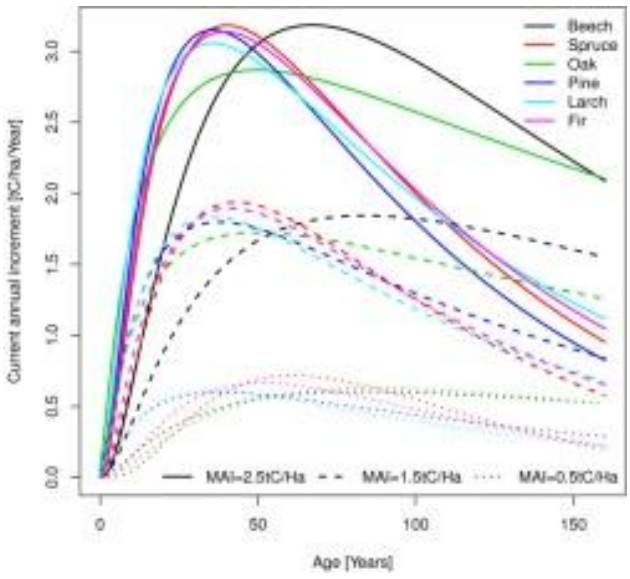
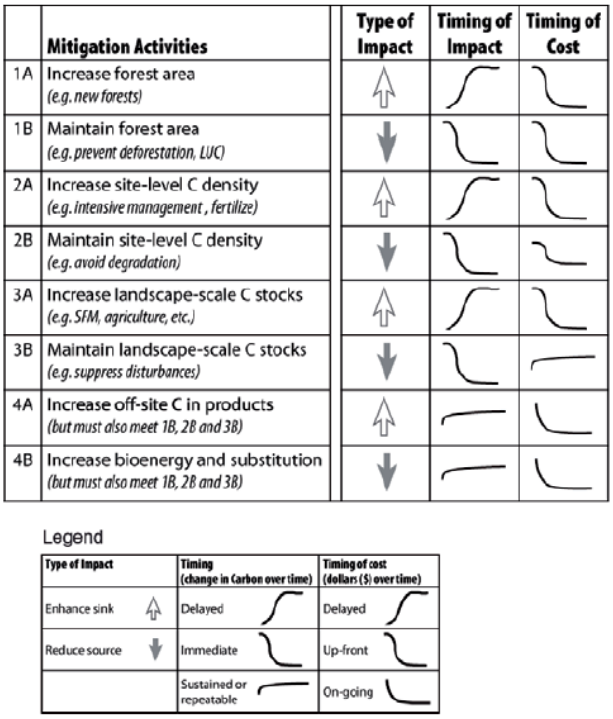


Figure 7: Generalized summary of forest sector options and type and timing of effects on carbon stocks and the timing of costs (Nabuurs et al., 2007)



120. Consistent with Nabuurs et al. (2007) and Kinderman et al. (2013) findings, increasing harvesting in Romania to the annual allowable cut should be positive, especially when considering the mean increment of carbon sequestered when trees are growing. The modeling undertaken by JCA and ICAS show the reverse to be true based on the premise that young' stock replacing the cut stands initially have a low CO2 absorption.

121. The total CO2 removed per ha may be low at an early stage. The rate, however, at which the forest is growing and hence absorbing CO2 should be highest when the stand is young, with the exception of perhaps the first two or three years. Based on this rationale, increasing management intensity should result in a greater proportion of older trees being removed and a higher thinning intensity. While greater thinning of younger stands may not increase the overall growth of the stand, the growth is then concentrated on the remaining trees, and carbon has been removed in the thinning and is being used this for some other carbon beneficial process (e.g. fuelwood, which replaces use of fossil fuels, or it is stored in chipboard or paper).

122. A possible explanation for this discrepancy could be that there is a slightly skewed age class distribution. This can be addressed by both overcutting in some years and undercutting in others. And the potential implication of such an approach on CO2 removals should be explored when ICAS revisits the model.

123. The scenarios presented in this section do not include protection forests. Sustainable management of protected forests, however, would increase the CO2 removal potential of forests because of their growth and resilience to biotic factors and climate variability. The increase in CO2 removal may be lower than that found in actively managed production forests because of the age class of trees in protected areas.

5. CONDITIONS NEEDED FOR FORESTS TO CONTRIBUTE TO CLIMATE CHANGE MITIGATION AND ADAPTATION

124. Forests can contribute to mitigation of climate change and also be affected by climate change (as described in Section 3 and 4). There are several enabling conditions necessary to foster no-regret options in the forest sector – or adaptation measures that also have mitigation benefits. This section briefly describes some of the main constraints to sustainable forest management and presents some actions for addressing these constraints. The section provides the basis for assessing the appropriateness of the measures related forest sector proposed by the Government of Romania for the NRDP and SOP Infrastructure (which includes measures on Environment). While, not the focus of this section, coordination among sectors is a key enabling condition. The latter enables sector to maximize synergies among them. While a challenging condition to put in place, there are sectors with which coordination will be fundamental. For the forest sector, a key sector to coordinate with is agriculture. Others important sectors include energy, infrastructure and water.

125. To implement any of the scenarios described in Section 4 and ensure the long-term maintenance of forest health, sustainable management has to occur on both state and private forest lands. The private landholders will need to be provided with the necessary support to comply with the requirements including technical services, markets, and infrastructure. Many of these will require public investments or financial support to buffer the upfront cost. As noted in the functional review of the forest sector (World Bank, 2011), "active management measures are required to ensure not only the maintenance of the forest as an ecosystem type but more specifically the conservation of a certain type of forest".

126. In Romania, climate sensitive sustainable management of production and protection will require reversing existing constraints in terms of technology, infrastructure, knowledge, research, and other enabling conditions (the same constraints that were described earlier). Additional investments in afforestation would enable the Romanian Government to increase harvesting in production forest to the AAC while minimizing any associated reduction in CO2 sequestration.

5.1 Management plans for forests

127. In Romania, management of forests must comply with national norms and technical parameters regardless of the size or forest type, or type of ownership. Forest management plans (FMPs), valid for a 10-year period, are drafted for each forest stand and specify the management prescriptions for the stand. The challenge imposed by this requirement is that FMPs on private land need to be prepared by specialized forest management planning companies. General Directorate for Forests within the Delegate Ministry of Forests also needs to approve the management plans, and compliance with the management plan is mandatory. Any changes in FMPs are obliged to be thoroughly substantiated and undergo an intricate and bureaucratic procedure before being accepted.

128. There are approximately 1 million ha of forests (approximately 15% of total forest area) without management plans. It is assumed that the majority of these are smallholders' forests because of the expense of complying with policy requirements for forest management planning. While in aggregate the area does not represent a significant portion of forest lands, these parcels are scattered throughout the forest ecosystem, creating fragmentation.

129. Another constraint, where management plans are available especially for state forest lands, is the lack of resources to approve and subsequently implement them. There are 272 management plans for protected areas, of which only five have been approved.

5.1.1 Challenges and opportunities to management of production areas

Outdated technical norms

130. Romania has a comprehensive forest regulatory framework including technical norms that regulate compositions, schemes and forest regeneration technologies (hereafter referred to as technical norms). The national forestry management norms and practices are in essence legacies from the past. They are a challenge to implement under the new reality of diverse forest ownership types and a dynamic economy (Stancioiu et al, 2010, as cited in World Bank, 2011). The extensive regulatory framework, considered excessive by many (Savcor Indufor 2006 as cited in World Bank, 2011) is a very prescriptive type of forest management regime, with an over-reliance on technical norms as opposed to general guidance regulations which allow for flexibility and innovation and which now form an increasing element of best forest practice (BFP) worldwide.

131. The technical norms need to be revised to be more flexible and allow accommodations in forest management that help mitigate and adapt to climate change. The revised norms should better reflect advances in forest management, forest operations and associated technologies (for example, nursery technology, seed quality, plant handling and site cultivation) (World Bank, 2011), and knowledge of climate change and its impacts on forests. For example, the norms should allow the adoption of one of the best ways to lower the incidence of forest fires -- to have firebreaks and to reduce the 'fuel' or combustible material found on the floor of forests, as these materials can cause the fire to spread quite rapidly. The associated forest management activities often include thinning – removing smaller trees, small diameter trees and low value species. Management often also involves removing understory vegetation that can be a source of ladder fuel.

132. Complementing the change in the technical norms should be an updating of the norms for harvesting and rotation lengths should reflect advances in growth and yield modeling and stand dynamics or on the financial viability of the management prescription for a particular stand.

133. A process was initiated to update the technical norms, but did not advance. The process needs to be revived and done with stakeholder engagement to ensure that new norms provide guidance that all relevant stakeholders understand. Adopting this approach would ensure the development of the norms meets best practice (World Bank, 2011). Changes in policy restrictions on forest management need to be complemented with changes in standards for wood harvesting. The revised standards should

account for the new technologies that can be adopted and considerations for how to adapt the new technologies to the Romanian context.

Simplifying regulations on administering forests

134. Under current regulations all forests need to be managed according to the technical norms, independent of size. Accordingly, a recognized forest administration entity (e.g., Romsilva or a PFD) must be contracted to administer small privately owned forests to ensure it is in compliance with all the legal requirements. Current regulations also require a forest administration (private or state) to accept the management of any privately owned forest if the landowner agrees to the forest administration's published offer price for managing the forest. Under these circumstances, the administration is obliged to provide management and enforcement services independent of whether the private owner pays the agreed fee. Forest administrators, such as Romsilva, are increasingly having to provide such services and incur costs on behalf of non-paying forest owners. To exit from the contract entails significant transactions costs. It requires the administrator to prove that there is no illegal harvesting in the area in question, which requires involvement of the Territorial Inspectorate for Forests and Hunting. (World Bank, 2011)

135. The costs associated with complying with the technical norms and forest management planning requirements have created a situation whereby small forest owners struggle to comply with all the legal and regulatory requirements. As a result, there are logging activities that, although potentially sustainable, are occurring without a formally approved management plan. These activities are considered illegal because they are in violation of the law. In addition, there are also unsustainable logging activities. In both cases, the forest owner has limited options regarding what to do with the wood, because it is considered illegal.

136. The Territorial Inspectorates for Forestry Regime and Hunting are responsible for controlling illegal logging. For the Inspectorate, the challenge is controlling the activities of private forest holders that fall outside of national parks. To date, the effectiveness of the control has been limited (89 cases out of 2,263 resulted in fines being imposed). It is estimated that 100,000 m^3 is illegally logged each year (NDRP 2007-2013). This underscores the importance of putting in place legal requirements that are not onerous and providing incentives for compliance.

137. A simplified regulatory regime for small privately owned forest areas is required. The simpler regulation should enable owners of forests under 10 ha to adhere to good forest practice and SFM guidance with simplified requirements for planning, marking, harvesting and sale of timber and non-timber forest products. (World Bank, 2011)

5.1.2 Challenges and opportunities for management of protected areas

138. At the end of 2011 approximately 50% of the total protected natural areas in Romania were under management, administration or custody of Romsilva. By 2012, out of the 272 management plans that had been drafted (or drafted through SOP ENV), 5 management plans had been approved (3 for national and natural parks and 2 for Natura 2000 sites). There is the opportunity to approve more of the management plans that are already prepared and to prepare plans for the remaining areas by:

- Rectifying the limited administrative capacity in the environment authority
- Undertaking a campaign to promote a wider understanding of the importance of biodiversity conservation, especially among private owners
- Fostering management practices that reconnect natural areas that have been artificially divided, and form a functioning network
- Restoring degraded natural areas to create a new space for animals, plants and leisure activities and prevent disasters

139. The objective of protected areas is often to safeguard biodiversity and ecosystem services. Management plans for protected areas, therefore, must take into account climate change adaptation needs for the species and ecosystem services they were designed to protect. Lack of explicit consideration of climate change in the management plans, reduces the utility of protected areas in building the resilience of forest systems to climate change.

Incentives for private landholders to meet Natura 2000 objectives

140. Thirty six percent of Natura 2000 sites are under private ownership. MoEF analysis (2010) found that 40% of land under administration of PFDs is now included within Natura 2000 sites (World Bank, 2011). The private landholders, through the PFD, need to achieve Natura 2000 objectives of maintaining or restoring the "Favorable Conservation Status" for the natural habitats and species. The PFD needs to comply with the FMP requirements as well as the Natura 2000 requirements.

141. Alignment of the two sets of requirements needs to occur to foster synergy between the objectives rather than tension with local communities. In addition, the incentive payments need to be rethought. The European legislation on compensation measures (Council Regulation EC1698/2005) provides financial compensations for private property owners. This does not include community held property, which in Romania, cover large areas inside of the proposed sites of community interest. For private property, approved site specific management plans are required to access Natura 2000 compensation payments.

142. To lift the current challenges to achieving Natura 2000 objectives, there is the need to develop a simpler way of ensuring that private lands within designated Natura 2000 areas are managed accordingly. This may involve providing needed incentives to property holders and also making more transparent how compensation is determined. Identifying a way to compensate communes managing lands under Natura 2000 is equally important. Areas designated as Natura 2000 have to have their own management plans. Accordingly, it will be important to develop and promptly implement a methodology for approving the site specific Natura 2000 management plans. An option would be to delegate the mandate of approving management plans to local agencies of the MoEF, as the

Directorate of Biodiversity currently does not have the capacity to implement the process at the scale required. Lastly, the government should also consider whether there economics justify purchasing the private landholdings and managing the sites.

Biodiversity conservation

143. In addition to Natura 2000, management of low altitude, broad-leaved forests on the plains is also important for biodiversity conservation. There also is the need for management plans for natural habitats, to prevent and limit the degradation caused by climate change. Management plans should include appropriate measures to protect the natural and semi-natural habitats close to the agricultural areas. Lastly measures to increase forest areas by rehabilitating degraded lands and other lands could create additional habitat for biodiversity. (source: http://www.climateadaptation.eu/romania/biodiversity/)

5.1.3 Opportunities and Challenges to Afforestation

National Programme for Afforestation

144. The National Programme for Afforestation projects a 422,000 ha increase in area under forest cover by 2035. 20.3% of the area for afforestation is currently degraded forest land that is part of public or privately owned forest land, 8.5% will be windbreak forests and 7.2% degraded agricultural land that is unsuitable for agriculture (Bohateret, 2012). The afforested area will total 340,200 ha, increasing the total forest cover to 29.3 percent at an average annual growth rate of 0.04% for 25 years. (Bohateret, 2012).

145. Funding for the National Programme for Afforestation is obtained from multiple sources. All forest administrations (public and private) have to set aside 15 percent of their timber revenue for a regeneration reserve. The funds are then used for reforestation and afforestation activities. Activities to afforest degraded lands are also financed through the National Environmental Fund (2009). There are specific guidelines for accessing these funds. EU accession resources were also available for afforestation.

146. While funding is available, the rate of implementation has been slow. Georgescu (2009) reviewed the afforestation efforts on lands at the margin of agricultural cultivation. For the programming period between 2005 and 2009, 5000 hectares per year had been reclaimed from degraded lands (this was financed through budgetary allocations). The first afforestation of agricultural lands (Measure 221 – NRDP 2007-2013) had programmed for afforestation of approximately 50,000 ha. Between 1990 and 2009, 30,586 ha have been afforested at the national level primarily on degraded lands (ICAS modeling paper). However, from 1990 to 2000 the average afforestation rate was 477ha/year compared to the level of afforestation of 25,336 ha of degraded lands (average of 2,815 ha/year) achieve between 2001 and 2009. Between 2000 and 2009, forest belts covered an area of 1,107 ha.

Incentives to private landholders for afforestation and restoration of degraded lands

147. Incentives will be important for successful afforestation initiatives. Of the 115,129 hectares of degraded area found suitable for restoration through afforestation in 16 counties (roughly 14% of the land area), more than 80% is under private ownership or community management of public lands.

148. A barrier to the creation of forest belts is the lack of financial resources to support such activities, especially for smallholders. In 2005-2006, ICAS developed technical designs for 19,965 ha of forest belt, of which 3,460 ha were designed to protect 1,150 km of roads and highways. Subsequently, a regulation was drafted to create a framework for the owners to agree with afforestation of some of their land (Governmental Decision 994/2004), if the land allocated by the landowner was part of the forest belt network that was being designed. Unfortunately, the program managed to afforest less than 1% of the programed surface. The main reason for this poor performance was the fact that the owners were not properly compensated. The legislation was modified in 2011 (Law 213/2011) and included payments for land owners and required that the land under the forest belts be nationalized. This revised initiative, however, was also blocked because of limited budget.

5.2 Opportunities and Challenges with Necessary Enabling Conditions

5.2.1 Information on Land Ownership

149. After restitution, 828,000 small holders own 0.85 million ha of the 2.2 million ha that are under private ownership. This has fragmented the forest estate and raised challenges for ensuring sustainable forest management. Providing incentives for sustainable forest management or enabling consolidation initiatives requires knowing who owns each parcel of forests and each parcel's boundaries. Currently this information is not available as there is no cadastre of forest lands.

150. Private forest owners, especially smallholders, often need simpler requirements and financial support to deliver SFM – whether for protection or production purposes. Compensation payments available through Natura 2000 and other programs could be suitable incentives. The lack of information on ownership, however, presents a challenge to implementing compensation payments for private owners. In the case of Natura 2000, where there are cadastral maps and evidence of forest properties, the electronic information is currently incompatible with the IACS (the IT system used by the agency that makes the payments). This creates a situation where the absence of accessible information on who owns the land, where the boundaries are and how to adequately compensate the private owner, makes it impossible to operate the payments system.

151. Investments in forest cadastre can result in clarity over ownership, limited court disputes over property, secure mortgages, simplified application of taxation requirements, development of market over forest properties, and more efficient investments. Information on ownership also improves the targeting of interventions. This enables more efficient use of funds for administering measures to adapt forests to climate change. Current technological advancements can facilitate rapid and participatory roll out of a national cadastre at a reasonable cost (Deininger, 2013 personal

communication). Another effective way of generating the necessary information through a forest cadastre is by integrating forests as one of the priority sectors in a national cadastre.

5.2.2 Improve Accessibility

152. Limited forest roads for accessing forests are a significant constraint to SFM in Romania. The average road density for Romania is 6.4 m/ha (World Bank, 2011). This is significantly below other European countries with broadly similar topography (Austria 36 m/ha, Switzerland 40 m/ha and France 26m/ha). A low density of forest roads implies the lack of access to timber resources in inaccessible sites and/or the need to skid logs longer distances from the point where they are felled to roads where they can be loaded onto trucks. As a result, harvesting levels are below the recommendations of forest management plans in inaccessible areas, accessible forest stands are over harvested, fire and pest control are inefficient due to lack of access, etc. In addition, exploitation costs are higher since they increase with the length of skidding. From an environmental perspective, the longer skidding distance results in erosion and soil compaction on arterial skidding trails. In addition, damage to the forest floor and standing trees increase in proportion to the dragging distance to the closest road. Lack of maintenance can cause road deterioration and as such sedimentation of water courses. Thus, a forest road network of adequate density and quality is essential for an efficient and environmentally sound forest management (World Bank, 2008).

153. Intensive forest management activities require construction, rehabilitation, and maintenance of good forest roads to facilitate access to the forest. The construction and rehabilitation of forest roads can have both positive and negative impacts. There is a need for a careful planning and design to prevent, minimize or mitigate unintended negative impacts and enhance positive impacts. These impacts are directly related to the density and quality of a forest road network.

154. Good forest roads lower costs of general management, maintenance, timber extraction and recreation. They enable cost-efficient and low-impact harvesting, pest protection and fire management. Forest roads can serve as fire breaks and can facilitate deploying fire-fighting equipment. Good forest road system enables regular monitoring of forest health, including research, inspection for insect infestation and diseases, and responding promptly when necessary. Apart from initial establishment, roads represent the single greatest capital investment by the owner. Well planned and quality forest roads, however, can help lower the cost of harvesting and extraction of timber, making sustainable management profitable. There are also recreational benefits from roads.

155. To prevent increased accessibility of forests resulting in excessive extraction of activities that degrade the forest, the Government of Romania will need to ensure that road development and maintenance is done where it is most justified in terms or profitability and that the estimation of profits incorporates the emissions and sequestration of CO2.

National effort to improve accessibility

156. Law 56/2010 on national forest accessibility requires that all forest administrations (public and private) set aside a portion of their revenue to contribute to road rehabilitation. Forest administrations are to set aside 10% of the timber revenue for road construction and rehabilitation. The funds are

designed to assess feasibility, design, construct and rehabilitate the roads. Despite these efforts, the level of forest accessibility in Romania remains low.

5.2.3 Information on the Resource Base

157. Sustainable forest management is information intensive. Inclusion of climate resilience measures in the management approach also requires updated and current information from models and continuous monitoring. SFM requires comprehensive information on the resource base and access to information on latest management methods, pest prevention, and approaches for reducing loss of wood. The NFI, which has been funded from the state budget was stalled due to the withdrawal of sufficient funding to complete the final field data collection and analysis/reporting phase (World Bank, 2011). A recently signed accord between ICAS and the central authority will allow the continuation of the current NFI. This positive development needs to be augmented with financial resources that would allow for the continuous collection and analysis of NFI data. The latter would enable, *inter alia*, adequately estimating carbon sequestration. The NFI data have the potential to facilitate the carbon accounting for forestry.

158. Another area of need is improved access to information on new technologies usable for forest management, harvesting and processing. Extension support is needed on numerous matters, including how to manage the forest resource to maximize its multiple benefits, and how to account for ecosystem services, how to plan for climate change impacts and adapt forest management.

159. The Government of Romania needs to support, either with public resources or with private cofinancing or use of technical service providers, access to information for improving and enabling SFM. Similarly, the Government needs to identify resources to support more frequent monitoring of the parameters compiled through a NFI, to improve national and private entities understanding of forest system dynamics and the impact of climate change on the system. The Government should also explore how to tap into the extensive capacity available in the forest sector of Romania

5.2.4 Strengthening Research, Database Harmonization and Information Sharing

160. Despite the recognition of the importance of data and analysis for planning and efficient management of the resource base, research in the forest sector remains underfunded. For example, research on the impact of climate change on biodiversity (for example on the occurrence of invasive species) requires additional resources. There also is space to improve coordination among the three main research entities and to harmonize databases, enabling scientists to conduct studies that are more representative of the country and have panel data. Considering the measures proposed by the Government of Romania for the forest sector in the NRDP, there is need for researchers to collaborate on topics such as: afforestation, new forestry technology usage, forest roads construction and rehabilitation techniques, and valuation for adequate estimation of compensation payments.

161. Given the extent of private forest ownership in Romania, there is urgent need to better understand the economics of the sector. Trade and industry organizations have conducted research on the wood industry in Romania. These studies, however, are seldom tied back to the resource base. Studies on small holder forestry are also limited.

5.2.5 Monitoring of Forests

162. Currently, there is monitoring of forest resources occurring at different levels (whether it is for research or for monitoring to inform production activities) and through the activities of the national forest inventory. Generally the system has significant room for improvement – including monitoring biotic factors that are affecting the health of forests such as invasive species and pest outbreaks. There also is need to improve monitoring systems for better assessing the interaction between the proposed measures and carbon sequestration.

163. Implementing and maintaining a new state-of-the-art monitoring system can be expensive. There, however, are opportunities to use available remote sensing technology (e.g., used by European Space Agency which has relatively low cost but high resolution) and to complement this with ground data from the PFDs and Forest Inspectorates efforts to assess compliance with management plans to develop a system for monitoring emissions.

164. To effectively monitor carbon sequestration, however, it will be necessary to put in place permanent monitoring plots or add to the existing permanent monitoring plots to ensure there is representation of forest vegetation types (species), soils and climate. These permanent monitoring plots must be stable over the course of monitoring, therefore it will be important to record their location and code them according to their attributes. The available carbon in these PMPs will then need to be determined in order to set a baseline.

165. To facilitate such monitoring the sector will need to develop systems for data collection that are compatible among each other, enabling pooling of data to assess both compliance and impact. Using data emerging from the NFI, the sector will need to put in place a system for monitoring harvesting and planting. This information, aggregated with available information on carbon emissions would be used to approximate the impact of the sector on climate change.

5.3 Cost Effectiveness of Using Forests to Mitigate Climate Change

166. The several constraints to achieving SFM raises questions regarding the cost effectiveness of using forests to reduce GHG emission compared to measures in other sectors. The use of forests to abate CO2 emissions is difficult to compare with more conventional technological measures in particular sectors, because of the several non-market benefits that forest management offer (arising from ecosystem services). There, however, are few examples where this has been done. An example, for purposes of illustration is in Russia, where the marginal abatement cost curve analysis also included afforestation/reforestation activities. In Russia, abatement measures involving forests were considered profitable. A similar conclusion was reached in the UK.

167. Limited availability of data for the forest sector in Romania makes it difficult to present marginal abatement cost estimations for specific forest management approaches, similar to what was done in Russia and the UK. A more detailed analysis of the economic benefit and cost will be important to inform prioritization of the proposed measures and efforts to refine them.

168. One of the challenges with an economic analysis is capturing the broad range of benefits from sustainable management of production forests and afforestation. These include positive economic and social externalities (e.g., employment, revenue from trade, social inclusiveness and secure benefits) and partially positive environmental externalities (e.g., flood prevention, erosion control and resilience to climate change). Moreover, increased harvesting of trees allows for greater carbon sequestration as the trees regrow and mature (year 5-40), after an initial decline in carbon sequestration. There are also benefits stemming from the reduced incidence of fires. Afforestation has positive environmental, economic and social externalities similar to those mentioned above. Furthermore, the cost of forest management currently is significantly higher than optimal. A 2006-2007 study of Romsilva found that there were ways to reduce the NFAs its operating costs by 58%. Such a reduction in cost complemented with improved road infrastructure would increase the net benefits of sustainable forest management and managing forests to enhance resilience to climate change.

6. MEASURES FOR EU FUNDED OP 2013-2020.

6.1 2007-2013 programming cycle of NRDP and SOP Environment

169. The NRDP for 2007-2013 had the following three objectives (NRDP, 2010):

- Facilitate the transformation and modernization of the dualistic structure of agriculture and forestry, as well as its agro/wood-processing industry to ensure their competitiveness, contribute to growth and income convergence in rural areas (where possible), while ensuring the living conditions and environmental protection of these areas.

- To maintain and enhance the quality of the rural environment in Romania, by promoting the sustainable management of both agricultural and forestry land.

- Manage and facilitate the movement of labor out of agriculture into other sectors that can ensure adequate economic and social living standard.

170. Nine measures[20] of the NRDP directly or indirectly targeted the forestry sector:

- Professional training, information and knowledge dissemination (measure 111)
- Use of agriculture consulting services by farmers and forest owners (measure 114) and providing farm advisory and extension services (measure 143)
- Improving the economic value of the forests (measure 122)
- Increased value added of farming and forestry products (measure 123)

[20] The budget for advisory (€ 158.69 million) is split into two measures: measure 114 (€ 95.2 million) and measure 143 (€ 63.5 million).

- Improving and developing the infrastructure, in connection with the development and adjustment of agriculture and forestry (measure 125)
- First afforestation of agricultural land (measure 221)
- First afforestation of non-agricultural land (measure 223)
- Natura 2000 payments, forests (measure 224)

171. One of the priority axes for the SOP Environment was "[i]mplementation of adequate management systems for nature protection". The objective included:

- conserving biological diversity, natural habitats, wild species of fauna and flora, and
- ensure efficient management of protected areas, including Natura 2000.

172. The emphasis was on development of an adequate management framework for protected areas, including Natura 2000 sites. This included development of infrastructure for protected areas as well as maintenance, operation and monitoring activities. There were also measures for raising public awareness for environmental protection. The support was focused on preparation and implementation of management plans. There also was support to the building the administrative capacity of the then new National Agency for Protected Natural Areas and Biodiversity Conservation (SOP Environment, 2007). There also was consideration for securing compensatory payments for activities that contributed to environmental protection (SOP ENV., 2007)

6.1.1 Achievements

173. The achievements under the current NRDP and SOP Environment. Some of the achievements include

- Measure 123 – Increasing value for agricultural and forestry products: support was provided for 135 forestry projects with a value of € 64,505,746.00 from a total allocated sum of € 150,000,000
- Measure 125 - Forest Roads: 1623 Km of forest roads were rehabilitated as a result of support to 136 projects. The amount allocated to these projects was approximately € 152.1 million. The target was 2010 Km of rehabilitated roads for € 162.72 million
- Measure 221 – First afforestation of agricultural lands: The target for this measure was 14,180 beneficiaries and 49,349 ha afforested. The measure has reached 26 beneficiaries and afforested 649 ha. The budget spent was € 3,085,357 which is approximately 0.13% of the total allocation of € 229,341,338. The unused budget was already reallocated to other measures within agriculture sector

174. The financial allocation for the SOP Environment was €4.5 Billion. The absorption rate was 12.7% and the certified absorption rate was 3.4%. Two of the measures with low absorption rates were the measures for Natura 2000 and Afforestation of agricultural lands.

175. While there has not been a systematic review to assess reasons for low absorption, experts' point to the design of the measure on afforestation of agricultural lands. Some of the constraints included:

a. A high percent of co-financing was required from the side of funds beneficiary (especially private owners or SMEs);

b. There was a very low level effort to raise awareness prior to, or in coincidence with the launch of afforestation measures;

c. The application requirements (including eligibility criteria) were onerous and was not set up to effectively reach the target beneficiaries; and

d. Unclear project approval criteria that was seemingly not fair for all the potential beneficiaries.

6.2 Proposed Measures for 2014-2020 Programming Cycle

176. The regulation of the European Parliament and of the Council (hereafter referred to as Regulation) on support for rural development by the development of the European Agricultural Fund for Rural Development (EAFRD), details how financial resources can be allocated. There are several articles within the regulation that are of relevance for the forest sector. The mains ones are detailed here:

a. Article 18 (paragraph 1, letter c) concerns infrastructure related to the development and adaptation of agriculture, including access to farm and forest land, land consolidation and improvement, energy supply and, water management.[21]

b. Article 18 (paragraph 1, letter d), article 22 (paragraph 1, letters a, c, and d) covers: i) afforestation and creation of woodland, ii) prevention and restoration of damage to forests from forest fires and natural disasters, including post disease outbreaks, catastrophic events and climate related threats and, iii) investments improving the resilience and environmental values as well as the mitigation potential of forest ecosystems.[22]

c. Article 22 (paragraph 1, letter e) covers investments in new forestry technology and in processing and marketing of forest products.[23]

d. Article 25, 37, 39, 39 and 40 covers insurance and mutual funds in forestry.

e. Articles 31 – Natura 2000 payments - and 35 – Forest environmental and climate change and forest conservation.[24]

[21] This is similar to the former NRDP measure 1.25 on infrastructure for development and adaptation of agriculture and forestry, including access to agriculture and forest surface, consolidation of land, energy delivery and water management.

[22] These are similar to the former NRDP measure 221.

[23] This is similar to former NRDP measure 122 and 123

f. Article 36 focuses mainly the development of new practices and technologies in the forestry sector.

177. The Delegate Ministry of Forestry has put forth to MARD a proposal for the upcoming 2014-2020 programming cycle which includes the following measures and associated financial envelopes. It is to be noted that the figures presented below are only indicative and mirror only the funds required as they are indicated by the GDPSPWFF:

- Improving forest accessibility by maintaining and building forest roads and other accessibility facilities ((article 18 in the EU Regulation for programming 2014-2020 CSF)): € 700 million
- Investments in new technology, processing and marketing forestry: products (article 22) € 300 million
- Implementation of Natura 2000, afforestation, and establishment of forest belts (article 31 and 35): € 2500 million
- First afforestation of agricultural lands (article 22): € 250 million
- Training and consultancy (article 15 and 16): € 70 mill
- Support for organizing the supply chain in forestry: € 50 million
- Insurance and mutual funds in forestry: € 45 million
- Support for innovation and collaboration: € 15 million

178. The proposed measures were identified through various analyses, including a strengths, weakness, opportunities and threats (SWOT) analysis. They financial allocations also reflect an assessment of need and considerations based on experiences from the absorption of the funds associated with the NRDP measures. Some of the key reasons provided by the GDPSPWFF include:

a. The proposal for roads stems from the urgent need for a better access to the forests and the need to improve the low quality of present forest roads to reduce the negative impact poor road access can have on sustainable management of forests and in turn CO2 emissions. Furthermore, the success of the former measure 125 in the 2007-2013 NRDP reinforces the need – nearly all the funds available were consumed and a long list of potential projects remains. The proposed financial allocation for this measure is rather high, reaching almost double the level allocated between 2007 and 2013.

b. Many forest companies have not upgraded their technology. This has implications for forest management and the impact it has on soil and the efficiency of management. The

[24] This is similar to the former NRDP measures 211, 212, 214

proposed measure on technology aims to rectify this. The performance of the similar measures, under the NRDP, was successful.

c. The proposed measure on Natura 2000 reflects the need to compensate forest owners who have to comply with the Natura 2000 directives 92/43/EEC, 2009/147/EC and 2000/60/EC. While in the former programming period no funds were spent for this under the NRDP, the Forest Directorate is confident that forest owners are now more familiar with the Natura 2000 requirements, and the Natura 2000 restrictions will be included the forest planning technical guidelines.

d. The analysis conducted by the GDPSPWFF has informed the selection of the measure on afforestation of agricultural land. This measure would enable sustainable management of forest and also increase the area under forest. The Directorate has set a high target and will implement the measure in a manner that overcomes some of the constraints that resulted in poor implementation of the former NRDP measure 221 on afforestation of agricultural lands.

e. The GDPSPWFF identified facilitating the establishment of producer groups as important. The underlying reasoning is to assist private owners to find SFM profitable. Because of the large number of private owners with small forest landholdings, assisting these owners to form producer groups or associations would enable them to sell their timber and take advantage of economies of scale). This in turn would facilitate revenue generation for small and medium scale companies and encourage sustainable management by local enterprises.

f. The GDPSPWFF identified training and consultancies as important for the following reasons:

    i. The restitution of forests has transferred forests to individuals who have limited technical knowledge regarding forest management, requiring investment in capacity building;

    ii. Unlike during the former centralized forestry system, technical foresters today need to be able to operate in different forest biomes and update and adapt their skills to emerging demands;

    iii. Extension services for forest owners are limited making compliance with the prescriptive and highly technical regulatory framework a challenge. There is a need to facilitate greater capacity building

g. The proposed measure on insurance is justified by the fact that the intended afforestation target will require significant investments (e.g., production of forest seedlings) in agricultural or degraded land. These areas are subject to disk of natural disasters, and few insurance companies offer coverage for such events.

h. The measure on innovation and collaboration is justified by the urgent need to develop new technical guidelines including guidelines for sustainable adaptive measures for climate change.

7. RECOMMENDATIONS AND CONCLUSIONS

179. To comply with the requirements of allocating 30% of the funds for the NRDP to climate change, approximately € 1,179 million of the proposed amount of € 3,930 million will need to have significant positive climate relevance.

180. The assessment found that at a minimum sustainable management of production forests complemented with afforestation would positively contribute to CO2 removal. Increasing intensity of management is likely to result in greater CO2 removal and should be further assessed by ICAS once information is available from the NFI. A similar conclusion can be ascertained for sustainable management of protected areas.

181. The institutional and economic conditions that facilitate SFM need to be put in place to ensure that the proposed measures for the upcoming programming cycle have positive climate relevance. If SFM that enhances climate resilience is profitable, there will likely be an increase in the level of compliance with management plan requirements and of sustainable forest resource use.

182. If implemented properly, many of the government proposed measures will have positive climate benefits. This will result in more than 30% of the funds meeting the EU requirement on climate change. This section briefly discusses each of the proposed measure and provides qualitative recommendations on how to enhance the positive climate outcome from these measures. The recommendations also aim to help refine the measures recognizing the fact that the requested amounts are well in excess of the financial resources that would be available for the sector.

7.1 Recommendations regarding Government Measures

Improving Accessibility

183. The **measure on improving road access** will be fundamental for ensuring forests help mitigate climate change because of the net benefits for SFM. Rehabilitation and extension of road infrastructure can have significant economic benefits. For example, the analysis from a 2006 World Bank project including road rehabilitation, found that economic internal rate of return (EIRR) of the investment in road rehabilitation comes to 107% for the whole roads program. The main benefits were :

- Lower costs of harvesting;
- Increased accessibility to forests which would otherwise be inaccessible to harvesting at all;
- Reduced environmental damage caused by poorly maintained roads; and,
- Increased accessibility for other forest and non-forest resources such as mushrooms, berries, honey and upland pasture

184. Good roads facilitate fire management, greater efficiency in using forest management equipment, increased monitoring for pest and disease outbreaks, and overall effective forest management. The roads can also act as a countervailing force, to excessive harvesting, especially if it is illegal, because good roads facilitate enforcement. Roads are also important for lowering cost of management (e.g., fire and pest management) and monitoring (including monitoring for pests). All of these activities are important for the health of forests.

185. Drawing on experiences from the previous programming cycle, effective implementation of this measure will require carefully defining the eligibility criteria for the financial resources. In the 2007-2012 programming cycle, the selection criteria for road projects award 15/100 points for the beneficiary category, with the maximum score being associated with private forest owners and their associations and the lowest score of 5 being associated with Romsilva. This scoring disadvantaged Romsilva when submitting projects (World Bank, 2011). The description of beneficiaries also did not include PFDs making them ineligible for the financial resources (World Bank, 2011).

186. To effectively deliver positive climate outcomes with this measure it will be important to:

- To ensure that the roads that are rehabilitated and the new roads constructed improve the contribution of forests to carbon sequestration, by ensuring the eligibility criteria are inclusive of all the entities managing forests and require a clear indication of the potential reduction in GHGs as a result of the project;
- Financing provided for forest roads should be based on the economic rationale and direct and indirect contribution to climate change mitigation (including based on rough estimates of carbon sequestration or accumulation in the medium term) - the investments made through this measure should result in benefits that would not have arisen without the measure;
- Consider the current distribution of markets and capacity for timber harvesting and processing; and
- Raise awareness about the opportunity for financial support for road rehabilitation, maintenance and construction, including using the networks available to the forest associations.

187. The current funding request of €700million, while seemingly significant, would (using data from the previous programming period) allow for rehabilitation of roughly 7500 km of road. This would augment the rehabilitated roads by 2.5m/ha of production forest or 1.15m/ha overall. This addition still leaves Romania well below accessibility levels found in other comparable EU28 member countries. A more detailed analysis is needed to determine how much of the total available funds for the sector should be reallocated to this measure while ensuring it remains feasible to implement.

188. The measure of forest roads needs to be undertaken in the short and medium term to effectively deliver on its objective of facilitating sustainable forest management

Investing in new technology

189. The **measure on investing in new technology, marketing and processing** is well justified because it helps forest companies that have not upgraded their technology, improving SFM and having positive impact on soil and efficiency of management. It will also increase efficiency and improve value-addition and revenue from these products. To ensure this measure delivers positive benefits, the agency should:

- Give priority to co-financing environmentally friendly technologies;
- Ensure that if technologies are being "imported", support is provided to adapt them to the conditions under which SMEs are operating in Romania;
- Encourage the development of new technologies within Romania; and
- Provide information regarding what "environmentally friendly" entails;

190. Immediate adoption of new technologies is important to accelerate improvements in sustainable forest management and make the practice more economically viable.

Natura 2000 and Afforestation

191. The extent of private ownership of forests requires adequate policy measures and incentives for small and large private forest landholders to comply with the national objectives for forest resource management. This is especially the case for areas for protection that are designated Natura 2000 sites, of which 36% are on private landholdings. Prior to finalizing the **measure on Natura 2000**, it is necessary to assess the suitability of using compensation to improve compliance with Natura 2000 requirements. Use of compensation should be compared with the use of forest legislation to achieve Natura 2000 objectives (as is done elsewhere in Europe), and the possibility of using the funds to purchase private lands that are designated Natura 2000. Furthermore, the feasibility of compensation should be examined as EU regulations require a clear articulation of additionality to complying with Natura 2000 requirements to justify provision of compensation. If a compensation measure is put in place, it should involve a simple and straightforward mechanism for providing compensations. The funds should be accessible to all stakeholders groups, and the selection process must be inclusive.

192. There is limited data to assess appropriateness of the requested funding allocation (€2.5 billion) for this measure. Based on 2009 data, an allocation of €150 million would provide all private landholders with Natura 2000 sites with compensation at 2009 levels. Determination of the appropriate funding level for this measure requires updated estimates of the cost of administering and monitoring Natura 2000 activities, cost for afforestation of degraded lands, establishment of forest belts, and provision of compensation payments.

193. Given the increase in awareness regarding Natura 2000, there is a higher probability that the sector will be able to deliver on this measure more effectively during this programming cycle. Awareness raising, however, needs to still be done among small landowners who would be eligible for the compensation payments using current technology. A campaign to promote the use of the measure on innovation and collaboration to foster small and medium scale forest enterprise associations should

also be considered. Associations, several of which are already in existence and operating effectively, could increase the economies of scale. This is extremely important given the majority of private forest landowners have parcels that are smaller than 10ha.

194. To be successful in implementing the proposed measures and achieve the stated objective, the sector will need to:

- obtain additional resources to implement a forest cadastre nationally (this could also be done as part of an overall national cadastre) and to, at a minimum, complete the current national forest inventory. The comprehensive data generated through the cadastre and forest inventory would help prioritize geographic areas for NRDP financed activities, target compensation payments, and identify ways to facilitate sustainable forest management

- Address the institutional issues that constrained effective administration of the measures on afforestation and Natura 2000 during the last programming cycle

- Determine the appropriateness of using a compensation mechanism. Where a compensation mechanism is justified, analysis is needed to understand the level of compensatory payments for opportunity cost of compliance with Natura 2000 management requirements based on the ecosystems services values or based on a more robust assessment of intrinsic value of certain habitats

195. The **measure for Natura 2000, afforestation, forest belts,** should be disaggregated and the afforestation, forest belt activities should be merged with the first afforestation of agricultural lands. Use of funds for afforestation projects should prioritize geographic areas where the activity can generate multiple benefits such as combatting desertification and improving degraded lands. For example, some areas in south-east Romania are more suitable for afforestation and would significantly benefit from such investments. Another approach would to determine where to support investments in afforestation based on their potential benefit to adapting agriculture to climate variability.

First Afforestation of Agricultural Lands

196. The **measure on first afforestation of agricultural lands** can also help mitigate and adapt to climate change by enabling CO2 sequestration and contributing to resilience to climate change. The funding requested for this measure (€250 million) could enable the afforestation of approximately somewhere between 38,000ha and 100,000 ha (depending on where the projects are implemented). This is an ambitious target, and will require establishing and effectively using existing supporting services (from private or public sector) such as availability of good quality seedlings and extension support. In addition, there is need to:

- Prioritize afforestation projects based on areas with high potential and notable co-benefits;
- Keep the application and eligibility requirements clear and simple;
- Adopt inclusive criteria for eligibility;
- Ensure a significant portion of the upfront costs are covered with this measure;

- Improve the implementation arrangements for this measure, drawing on lessons from previous attempts to implement afforestation; and
- Raise awareness.

197. The impact of forestry measures requires time. Steps should be taken in the short term to put the necessary supporting systems in place to avoid any further delays (e.g., afforestation measures will initially require increased capacity for seedling production). This reality underscores the importance of initiating the measure early in the programming cycle to achieve the desired outcomes and envisaged impact on GHG emissions.

Training, value chain, insurance and support for innovation and collaboration

198. There is limited data for determining whether the measures that provide training, value chain development, insurance and support for innovation and collaboration for forest owners will have a positive or negative impact on CO2 sequestration. These measures are no regrets measures because even if measures do not directly contribute to an increase CO2 sequestration, they do not cause excess emissions.

199. Independent of climate benefits, there are other justifications for keeping these measures. For example, they will positively contribute to the process of developing the sector and improving its resilience to climate change by ensuring that the funds are accessible to all stakeholders and that the selection process was inclusive. Furthermore, there have been requests from the forest associations for training programs for forestry companies owners or employees on "environment friendly" practices (including the use of new technologies) and how to mainstream climate change into forest management planning

200. It will be important to complement the priorities of the innovation and training measures with the other measures of the NRDP. The application of the innovation and training measure should focus on building human resources and research on subjects/issues that would assist in effectively utilizing the new funds for afforestation, forest roads, new technology, assisting small and medium scale enterprises. This could include developing suitable approaches for prioritizing projects, innovative approaches for meeting the seedling requirement for afforestation, as well as increasing available capacity to implement the measures.

7.2 Summary of Recommendations

201. Table 7 below summarizes the specific recommended mitigation and adaptation actions in the forest sector. The recommendations are presented based on forest classification – protection, production – and also for afforestation. Cross-cutting recommendations are presented at the end of the table. It should be noted that for these actions to have the intended impact will require enabling institutional, policy, and planning conditions in the sector. Some of these are briefly described under specific measures and in more detail in the Assessment. The table also indicates when a particular measure is important by noting that it should be implemented in the short term.

Table 7: Summary of specific recommended mitigation and adaptation actions for the forest sector (Source: Authors)

Sectoral Focus	Action	Type of action, Linkage with Proposed Measure, and Timeframe
Production forest	Update technical norms for management, to make production forest management more efficient and effective, and reduce unsustainable practices that could result in GHG emissions. The technical norms should better reflect advances in forest management, forest operations, and associated technologies (for example, nursery technology, seed quality, plant handling and site cultivation).	Technical Assistance Linked with proposed measure on innovation and collaboration Short term
	Update technical norms for harvesting and rotations to reflect advances in growth and yield modelling and stand dynamics or on the financial viability of the management prescription for a particular stand. This helps to make harvesting of forest management more efficient and effective and reduce unsustainable practices that could result in GHG emission.	Technical Assistance Linked with proposed measure on innovation and collaboration Short term
	Simplify regulations for compliance with legal requirements for SFM for small privately owned forest areas. The simpler regulation should enable owners of forests under 10 ha to adhere to good forest practice and SFM guidance with simplified requirements for planning, marking, harvesting and sale of timber and non-timber forest products. This helps to make forest management more achievable for smallholders, reducing unsustainable forest management practices that could result in GHG emissions.	Technical Assistance Linked with proposed measure on innovation and collaboration Short term
	Review the modeling and analysis for CO2 removal from the three different scenarios examined by ICAS in recent climate modeling work (ICAS, 2012). This would require working with their existing permanent sample plots to undertake more growth and yield analysis. The objective is to confirm that	Technical Assistance Requires additional

	having more intense management would increase removal of CO2.	measure on research Short term
Protected areas	Increase area with management plans to enable sustainable forest management and therefore GHG removals: - Improve limited administrative capacity in the environment authority (also consider delegating authority to approve management plans to local agencies of MoEF) - Make available funds for implementation of management plans	Technical Assistance Requires additional measure or should be reflected by broadening proposed measure on Natura 2000 Short and medium term
	Promote management practices that enhance resilience of protected areas - Fostering management practices that reconnect natural areas that have been artificially divided, and form a functioning network - Restoring degraded natural areas to create a new space for animals, plants and leisure activities and prevent disasters	Technical Assistance Requires additional measure or broadening of proposed measure on Natura 2000 Short and medium term
	Incentives for Natura 2000 that ensure sustainable forest management: - Revisit the funding request for the measure on Natura 2000, afforestation and forest belts - Undertake a campaign to promote a wider understanding of the importance of biodiversity conservation, especially among private owners - Align requirements for forest management and	Technical Assistance Linked to proposed measure on Natura 2000

	management of Natura 2000 sites - Explore options for regulations to help implement Natura 2000 or use of available funds to purchase private land in areas designated for Natura 2000. - Make the compensation process for Natura 2000 more transparent	Short term
	Biodiversity conservation to reduce degradation and therefore reduce GHG emissions: - Develop and finance implementation of management plans for natural habitats, to prevent and limit the degradation caused by climate change. Management plans should include appropriate measures to protect the natural and semi-natural habitats close to the agricultural areas	Technical Assistance Requires an additional measure or extending measure on Natura 2000 Medium term
Afforestation	Incentives for Afforestation to enable sequestration of GHG: Owners need to be properly compensated to afforest their lands and keep part of their agricultural land under trees. Also need support to bear the upfront cost of afforestation	Investment and Technical Assistance Linked to measure on afforestation and first afforestation of agricultural lands Short term
	'Infrastructure' for Afforestation: Achieving the afforestation targets will require seedlings, technical support and extension services for management of afforested areas, and assistance to build market access for the sustainable extraction of poles or other wood products.	Investment and Technical Assistance Linked to measure on afforestation and first afforestation of agricultural lands Short term
Cross Cutting	Information on Land Ownership: Carry out a forest cadastre	Technical

Actions	to help with the implementation of incentive payments.	Assistance Requires an additional measure on inventory/ cadastre or inclusion with other ongoing cadastre. Short term
	Improve accessibility: Invest in maintaining, rehabilitating, and in some places, constructing forest roads, to lower cost of SFM and enable forest monitoring and fire management, reducing unintended GHG emissions.	Investments Linked to measure on Improving forest accessibility Short and medium term
	Completion of National Forest Inventory and periodic inventory work to help with the implementation of SFM.	Technical Assistance Requires an additional measure on inventory and monitoring or inclusion with other measures on monitoring and data collection Short term
	Information on new technologies usable for forest management, harvesting and processing to increase likelihood of SFM.	Technical Assistance Linked to measure on

		training and consultancy Short and medium term
	Research on impact of pests, invasive species and climate change on forest systems and tree species to assist with management and prevention of biotic factors that can cause GHG emissions from forests.	Technical Assistance Requires an additional measure on research or inclusion in another SOP that has research Short and medium term (has long term benefits)
	Capacity building for small holders to help with SFM and climate resilience. Need training and extension support is needed on how to manage the forest resource to maximize its multiple benefits, and how to account for ecosystem services, how to plan for climate change impacts and adapt forest management.	Technical Assistance Linked to measure on training and consultancy Short and medium term
	Greater understanding of the economics of forest management and access to markets to make SFM profitable and therefore help sequester GHGs.	Technical Assistance Requires an additional measure on research or inclusion in an SOP that has research Short and

		medium term
	Facilitate the establishment of producer groups to assist private owners to find SFM profitable.	Technical Assistance Linked to measure on support for organizing the supply chain in forestry Medium term
	Put in place a forest monitoring system to help reduce degradation of forests and therefore reduce GHG emissions.	Technical Assistance/ Investment Requires an additional measure on inventory/ monitoring Short and medium term

8. CONCLUSION

202. The forest sector of Romania is a key sector for mitigating climate change, as it is responsible for nearly 10% of reduction in GHG emissions. Forests are a major sink of GHGs and can help maintain, and potentially even increase, the level of GHG emissions reduced by the country. Forest based mitigation measures can include conserving existing CO2 sinks, enhancing carbon sinks and reducing the trade-off between the sinks and tangible and intangible benefits from other land uses.

203. An advantage of investing in the forest sector for mitigation is the co-benefits from SFM and forest conservation. Improved forest management and management practices that internalize the potential impact of climate change can build the resilience of forests to climate variability, enhance resilience of other sectors (e.g., agriculture) to disasters lowering their risk exposure, restore degraded lands, and provide a source of renewable energy for rural areas that has a low carbon footprint. Sustainable management of forests is instrumental for achieving Romania's international obligations and EU directives.

204. The restitution of forestlands has resulted in the transfer of nearly half of the state forests to private landowners. This accentuates the need for putting in place incentives for SFM. These incentives should motivate small forest owners and large forest owners. Accordingly, the incentives have to include monetary incentives and institutional and technical support (e.g., formation of associations and provision of extension services and training).

205. The Assessment finds that the proposed measures for the forest sector, including the funding allocation, exceed the EU requirement that 30% of the total allocation requested for the sector for measures that have positive climate relevance. Several of the measures (with the exception of the measure on Natura 2000), however, require additional funding to bridge the gap between current situation and optimal potential of the measures. The funding levels associated with the proposed measures, however, are more realistic given the timeframe within which the targets need to be met. There also is room to reallocate the amounts presented among the current measures

206. The proposed measures do reflect important areas of intervention in the short and medium term. They can, if designed appropriately, be inclusive in two ways. The measures can be inclusive with regards to who is eligible for the funding. The second way is in the objective of the measure. For example, the support for organizing the supply chain, training and consultancy, targeted at smallholders and small forest owners, would be inclusive and generate positive economic benefits.

207. The impact of forestry measures requires time. Immediate steps should be taken to put the necessary supporting systems in place to avoid any further delays (e.g., afforestation measures will initially require increased capacity for seedling production). This reality underscores the importance of initiating the measure early in the programming cycle to achieve the desired outcomes and envisaged impact on GHG emissions.

208. The sector should also consider addressing some of the challenges by integrating measures for forests in other SOPs, where appropriate. For example the conditions necessary for research could potentially be delivered as part of other SOPs that have a focus on research. There are other synergies that could be created through greater coordination among the public entities responsible for forests and those in other sectors. Key sectors for coordination include agriculture, energy, water and infrastructure.

209. Providing support for the forest sector through the NRDP and SOPs can be a "no regrets" investment. Many of the measures in the forest sector can jointly address mitigation and adaptation issues (e.g., afforestation of degraded lands). It, however, is important to ensure they do not have unintended consequences (e.g., decrease in CO2 removal). Monitoring change in carbon sequestration and monitoring harvesting and planting using some of the recently available technology and low cost system would assist in preventing negative outcomes.

REFERENCES

Abrudan, Ioan Vasile. 2012. "A Decade of Non-State Administration of Forests in Romania: Achievements and Challenges". *International Forestry Review* Vol.**14** (3): 275-284

Abrudan, Ioan Vasile, Viorel Marinescu, Ovidiu Ionescu, Florin Ioras, Sergiu Andrei Horodnic, Radu Sestras. 2009. "Developments in the Romanian Forestry and its Linkages with other Sectors". *Notulae Botanicae Horti Agrobotanici Cluj-Napoca:* 37 (2): 14-21

Abrudan, I.V., Marinescu, V, Ignea, G. and Codreanu, C, 2005. Present situation and trends in Romanian forestry.In: Legal Aspects of European Forest Sustainable Development: Proceedings of the 6th IUFRO 6.13.00 Group Meeting. Editura Universitatii Transilvania din Brasov, Romania:157–171

Albu, Anca Nicoleta, Marius Lungu, and Liliana Panaitescu. 2010. "Influence of Forest Curtains on Crops in South Dobrogea". *Research Journal of Agricultural Science*, 42 (3): 367-371

Author unknown. 2003. *Monitoring Plan for Changes in Carbon Stocks in Forest Plantations*. (Afforestation of Degraded Agricultural Land Project in Romania). Agreement between National Forest Administration: Romsilva and Prototype Carbon Fund

ICAS, 2013, *Carbon Sequestration Report over 10 year Period for 6000 Hectares, Bucharest.*

BERD, 2011. Assessment of the biomass chains including technologies and cost structure, Bucharest.

Borlea GF, Ignea G, 2006. The present forest policy and the market for forest products. Lucrările sesiuni ştiinţifice Pădurea şi dezvoltarea durabilă, Braşov, Romania, 2005-2006 pp. 633-638

Bohateret VM, 2012, Readjusting Romania's Forestry Policy with a View to the year 2050, Journal of Settlements and Spatial Planning, mr. 1/2012.

Brouwer, Roy, Luke Brander, Onno Kuik, Elissaios Papyrakis and Ian Bateman. 2013. *A synthesis of approaches to assess and value ecosystem services in the EU in the context of TEEB*. Final Report. VU University Amsterdam: Institute for Environmental Studies.

Centre for Climate Adaptation. Viewed July 2013. *Europe in a Changing Climate. Country report for Romania: Biodiversity report*. Access site: http://www.climateadaptation.eu/romania/biodiversity/

Badea Ovidiu and Stefan Neagu. 2010. "Volume Growth Losses for Trees and Forest Stands in the Romanian Intensive Monitoring System". *Proc. Rom. Acad.*, Series B, 2010 (3): 261–268

Chira, Danut, Florin Danescu, Nicolae Geambasu, Constantin Rosu, Florentina Chira, Vasile Mihalciuc, Aurelia Surdu. "Beech Decline Characteristics in 2001-2004". *Anal ICAS* 48: 3-20

Badea, Ovidiu, Andrzej Bytnerowicz, Diana Silaghi, Stefan Neagu, Ion Barbu, Carmen Iacoban, Corneliu Iacob, Gheorghe Guiman, Elena Preda, Ioan Seceleanu, Marian Oneata, Ion Dumitru, Viorela Huber, Horia Iuncu, Lucian Dinca, Stefan Leca, Ioan Taut. 2012. Status of the Southern Carpathian Forests in the Long-Term Ecological Research Network. Environ Monit Assess 184:7491–7515

Dragoi, Marin. 2010. "Compensating the Opportunity Cost of Forest Functional Zoning - Two Alternative Options for the Romanian Forest Policy". *Annals of Forest Research* 53(1): 81-92

Badea O., Neagu S., 2010, Volume growth losses for trees and forest stands in the Romanian intensive monitoring system. Proc. Rom Acad., Series B, 2013, 3, p. 261-268.

Busuioc Aristita, and Alexandru Dumitrescu. 2011. *Downscaled Climate change Projections for Romania* (a presentation). National Meteorological Administration: Bucharest, Romania

Chira D., Danescu F., Geambasu N, Rosu C., Chira F., Mihalciuc V., Surdu A., 2005. Particularitati ale uscarii fagului in perioada 2001-2004. Annals of Forest Research 48:3-20

Hlásny T, Turčáni M, 2009: Insect pest as climate change driven disturbances in forest ecosystems. In Strelcová et al. (eds) Bioclimatology and Natural Hazards, Springer Nederlands pp. 165-178.

Lange H, Økland B, Krokene P, 2006: Thresholds in the life cycle of the spruce bark beetle under climate change. Interjournal for Complex Systems 1648.

Neşu, I. 1999. Perdele forestiere de protecţie a câmpului" Edit. STARTIPP, Slobozia.

Olenici N, Duduman ML, Olenici V, Bouriaud O, Tomescu R, Rotariu C. 2011. The first outbreak of *Ips duplicatus* in Romania. In: Delb H, Pontuali S (eds.): Biotic Risks and Climate Change in Forests. Proceedings of the Working Party 7.03.10 Methodology of Forest Insect and Disease Survey in Central Europe, 10th Workshop September 20th-23rd, 2010, Freiburg, Germany. Berichte Freiburger Forstliche Forschung Heft, FVA: 135-140.

Dumitraşcu, Monica, Ines Grigorescu, Gheorghe Kucsicsa, Carmen-Sofia Gragota, Mihaela Năstase. 2011. "Assessing the Potential Distribution of the Invasive Plant Species Related to the Key Environmental Driving Forces in Comana Natural Park". *Proceedings of the 12th International Conference on Environmental Science and Technology*: B735-B742. Rhodes, Greece, 8-10 September 2011.

Duduman ML, Isaia G, Olenici N, 2011a: *Ips duplicatus* (Coleoptera: Curculionidae, Scolytinae) distribution in Romania. Preliminary results. Bulletin of the Transilvania University of Braşov, Series II, Vol. 4 (53) No.2: 19-27.

European Bank for Reconstruction and Development and Ministry of Agriculture and Rural Development. 2007. *Forestry and Forest Industry in Romania*. *Wood Sector Study*. Ministry of Agriculture and Rural Development: Bucharest, Romania.

European Commission. 2010. *Green Paper on Forest Protection and Information in the EU: Preparing Forests for Climate Change*. SEC (2010) 163 Final. Brussels.

European Environment Agency. 2011. *GHG Trends and Projections in Romania*

FRD Center. 2011. *Romanian Furniture Sector. 2011 Market Overview*. Report prepared for the Trade and Investment Promotion Section, Embassy of the Republic of Poland in Romania.

Georgescu, Olga. 2009. *Romanian Forest Policies for Mitigation and Adaptation to Climate Change.* Presentation made at FAO-REU Budapest, 2010.

Ioja CI, Patroescu M, Rozylowicz L, Popescu VD, Verghelet M, Zotta MI, Felciuc M (2010). The efficacy of Romania's protected areas network in conserving biodiversity. Biol Cons 143:2468–2476.

Ivan, Gheorghe. 2012. "Innovative Technology for Establishment and Maintenance of Crop Protection Forestry Belts and Combating of Drought and Desertification". *Annals of the University of Craiova - Agriculture, Montanology, Cadastre Series* Vol. XLII 2012/2: 359-365

JRC. 2012. Submission of information on forest management reference levels by Romania

Ministry of Environment and Climate Change. 2012. National Strategy on Climate Change 2013 – 2020. MECC: Bucharest, Romania

Ministry of Agriculture and Rural Development. 2013. NRDP 2014-2020 Ministry of Environment and Climate Change. 2013. Romania's Greenhouse Gas Inventory 1989-2011. National Inventory 2013. MECC: Bucharest, Romania

Ministry of Environment and Forests. 2010. Romania's Fifth National Communication on Climate Change under The United Nations Framework Convention on Climate Change. Bucharest, Romania

Ministry of Internal Affairs: General Inspectorate for Emergency Situations. 2013. *Reducing Vulnerability to Risks, Supporting Adaptation to Climate Change and Developing Disaster Management Systems*. Explanatory Note. Bucharest, Romania.

Ministry of Internal Affairs: General Inspectorate for Emergency Situations. 2013. *Risk Analysis of Fires*. Bucharest, Romania.

Nabuurs, G.J., O. Masera, K. Andrasko, P. Benitez-Ponce, R. Boer, M. Dutschke, E. Elsiddig, J. Ford-Robertson, P. Frumhoff, T. Karjalainen, O. Krankina, W.A. Kurz, M. Matsumoto, W. Oyhantcabal, N.H. Ravindranath, M.J. Sanz Sanchez, X. Zhang. 2007. *Forestry*. In Climate Change: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [B. Metz, O.R. Davidson, P.R. Bosch, R. Dave, L.A. Meyer (eds)], Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA

Naumann, Sandra, Gerardo Anzaldua, Pam Berry, Sarah Burch, McKenna Davis, Ana Frelih-Larsen, Holger Gerdes and Michele Sanders. 2011. Assessment of the potential of ecosystem-based approaches to climate change adaptation and mitigation in Europe. Final report to the European Commission, DG Environment, Contract no. 070307/2010/580412/SER/B2, Ecologic Institute and Environmental Change Institute, Oxford University Centre for the Environment

Popa, Bodgan and Camille Bann. 2012. An Assessment of the Contribution of Ecosystems in Protected Areas to Sector Growth and Human Well Being in Romania: Improving the Financial Sustainability of the Carpathian System of Protected Areas (PAs). Final Report.

Trombik J., Hlasny T., Dobor L., Barcza Z., 2013. Climatic exposure of forests in the Carpathians: Exposure maps and anticipated development. International Scientific Conference for PhD students.

World Bank. 2008. *Forest Sourcebook.* Agriculture and Rural Development Department, World Bank: Washington DC.

World Bank. 2009. Internal documents of Romania Forest Development Project. *Analysis of the Economic Impact of Forest Road Rehabilitation.*

World Bank. 2011. *Romania Functional Review: Environment, Water and Forestry. Vol 2: Forestry.* Europe and Central Asia Region, World Bank: Washington DC.