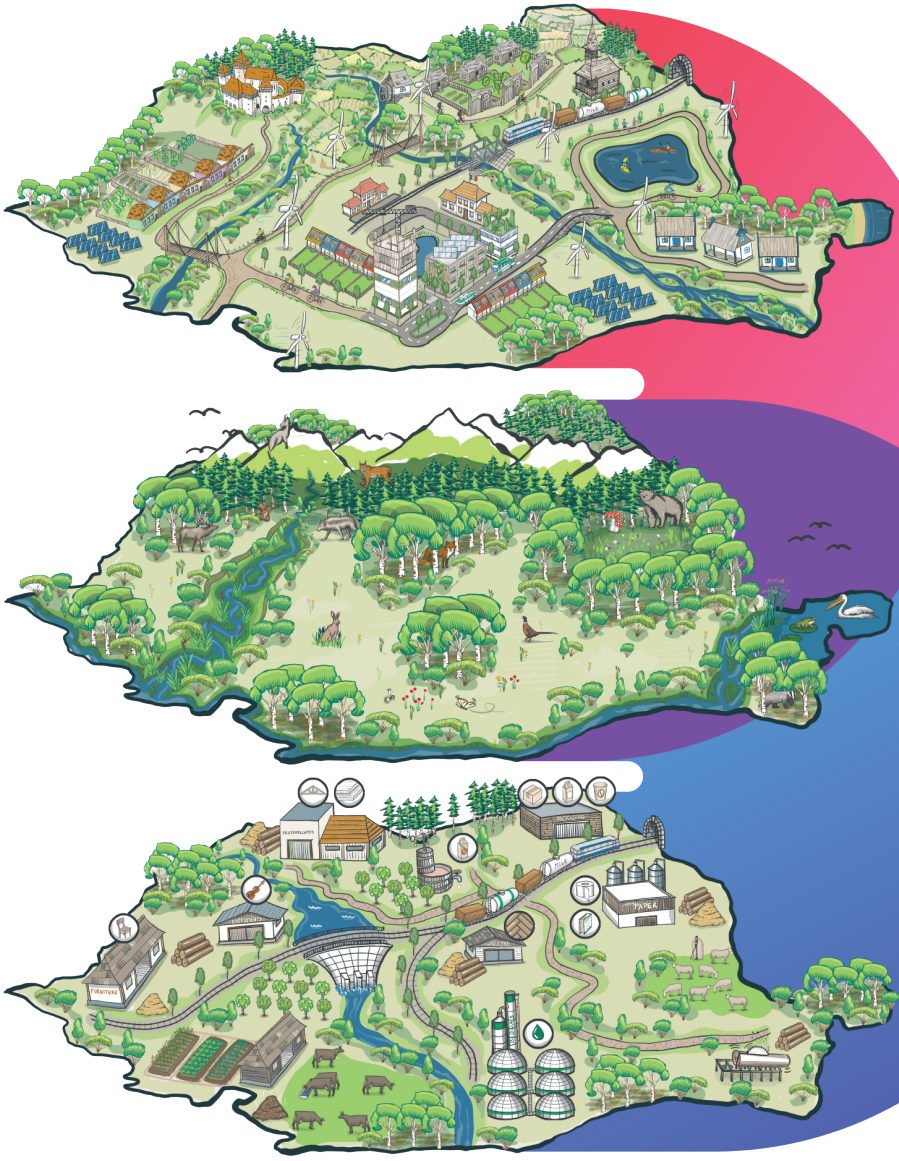
The Plan B

for Romania's Forests and Society



Editors: Alexandru Giurcă & Daniel Paul Dima

ROMANIA
BIOECONOMY
ALLIANCE

The Plan B

for Romania's Forests and Society

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BY HIS ROYAL HIGHNESS
THE PRINCE OF WALES

Photo credit: John Paul

CLARENCE HOUSE

Old wisdom and modern scientific investigation tell us that Nature is the result of a complex web made up of many forms of life, whose health and resilience depends on the biological diversity of the entire system.

Romanian people have understood the essential importance of living in harmony with Nature for centuries. Romania's well-preserved and productive landscapes are unparalleled in Europe and are remarkable for their scale. This, in my view, can be explained by the successful stewardship of the natural riches of Romania, where some of the largest patches of old-growth forests in the continent can be found and where, for instance, 200 species of butterflies exist.

We all have something to learn from the way Romania has been able to rely on regenerative approaches to create species-rich systems and socio-ecologically resilient landscapes in areas such as Transylvania, where people still live in harmony with Nature. Such landscapes, for which I have developed a great love over more than twenty years, have a spiritual but also social, economic and ecological significance.

However, the natural environment is increasingly under threat, putting at risk its natural ecosystems and unique rural communities that rely on them. While, increasingly, the world is recognizing the need to decarbonize our economy, we cannot forget about Nature's own economy as the root source of our supply chains. Here we need only look to agriculture, energy and fashion to see how Nature fuels global industries. When Nature is threatened, so too is our economy. It is critical, therefore, that we give back to Nature as much as we take from her. This principle is underscored by what some call a 'circular bioeconomy' which is about re-thinking our land, food and energy systems in favour of renewable, bio-based solutions, while enhancing biodiversity and furthering circular, waste-free models that are in harmony with Nature's principles.

It is in this context that I very much welcome this book's collection of scientific work from Romania and beyond, which shows that forest management and Nature conservation are not antagonistic, but that holistic and integrated approaches can offer a sustainable path that works for both Nature and people.

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ACRONYMS

Business-As-Usual - BAU
Central-Eastern European Initiative for Knowledge-based Agriculture, Aquaculture and Forestry in the Bioeconomy - BIOEAST
Chains of Custody - CoC
Common Agricultural Policy - CAP
Convention on Biological Diversity - CBD
Corporate Social Responsibility - CSR
Ecosystem Services - ES
European Commission - EC
European Forest Institute - EFI
European Union - EU
First Order Decay - FOD
Food and Agriculture Organization Corporate Statistical Database - FAOSTAT
Food and Agriculture Organization - FAO
Forest Management - FM
Forest Management Plans - FMPs
Forest Stewardship Council - FSC
Forest-Based Bioeconomy - FBB
Functional Categories - FC
Good Agricultural and Environmental Conditions - GAECs
Greenhouse Gasses - GHG
Harvested Wood Products - HWP
Industrial Roundwood - IRW
Intergovernmental Panel on Climate Change - IPCC
Multi-Level Perspective - MLP
National Forest Administration - ROMSILVA
National Forest Administration - NFA
National Forest Inventory - NFI
National Plan for Research, Development and Innovation - PNCDI
Programme for the Endorsement of Forest Certification Schemes - PEFC
Revealed Comparative Advantage - RCA
Association of Romanian Forests - ASFOR
Romanian Civil Society Development Foundation - CSDF
Sites of Community Importance - SCI
Special Conservation Areas - SCAs
Special Protection Areas - SPA
Statutory Management Requirements - SMRs
Sustainable Forest Management - SFM
The Agricultural Payments and Intervention Agency - APIS

The Association of Forest Administrators - AAP
The electronic wood traceability system - SUMAL
The United Nations Framework Convention on Climate Change - UNFCCC
Total Renewable Energy Sources - RES
Treaty on the Functioning of the European Union - TFEU
United Nations Economic Commission for Europe - UNECE
World Commission on Environment and Development - WCED
World Wide Fund for Nature - WWF

REZUMAT

Pădurile se află în centrul atenției societății ținând cont de rolul pe care îl au în furnizarea de multiple servicii sociale. Prin tranziția către o economie predominant circulară, bazată pe bioeconomie, putem reduce dependența noastră de combustibilii fosili și putem contribui la atenuarea schimbărilor climatice, la protecția mediului și la coeziunea socială. Dar, în ciuda progreselor înregistrate în ceea ce privește reforma politicilor forestiere, România nu a pornit încă cu adevărat pe calea bioeconomiei. Deși sectorul forestier este și va fi întotdeauna un pilon central pentru bioeconomie, sunt necesare noi moduri de abordare și de acțiune pentru ca tranziția spre bioeconomie să se și producă. Aceste noi moduri de gândire nu se limitează doar la modalități noi și îmbunătățite de gestionare a pădurilor și conservare a biodiversității, ci includ și noi modele de guvernanță adaptativă, abordări creative ale afacerilor și inovării, precum și o focalizare mai atentă asupra echității și incluziunii sociale în România, în vederea creării, împreună, a unui viitor comun.

Această carte este un apel la acțiune colectivă și integrată pentru o gestionare durabilă a pădurilor României în acord cu noile provocări ecologice, sociale și economice. Ea se adresează liderilor locali și globali, investitorilor, companiilor, oamenilor de știință, guvernelor, organizațiilor neguvernamentale și interguvernamentale, agențiilor de finanțare și societății în general. Cartea reprezintă opiniile unor experți români și internaționali a căror activitate științifică și practică este esențială pentru a ne ajuta să înțelegem cum se poate transforma sistemul actual de gestionare într-unul centrat pe paradigma bioeconomiei circulare. Volumul conține contribuții ale unor autori din medii de activitate diverse: cadre didactice universitare, practicieni, oameni de afaceri și reprezentanți ai ONG-urilor. Acest lucru oferă o varietate de perspective asupra provocărilor și oportunităților potențiale pe care le poate aduce o bioeconomie circulară. Cartea prezintă o abordare orientată spre viitor, bazată pe fapte, înrădăcinată în știință și în experiența directă. Prezintă planul B pentru pădurile și societatea din România - planul pentru o bioeconomie circulară.

Fără îndoială, bioeconomia s-a impus în Uniunea Europeană și în multe țări din întreaga lume. Până în prezent, au fost mobilizate investiții semnificative în tehnologie, cercetare și inovare. La momentul redactării acestui volum, aproape 60 de țări din întreaga lume dezvoltă politici[1] legate de bioeconomie. Până în prezent, România nu are o astfel de strategie națională în domeniul bioeconomiei. Cu toate acestea, este momentul potrivit pentru a îmbrățișa conceptul bioeconomiei, mai ales având în vedere că Guvernul României se află în plin proces de revizuire a strategiei naționale forestiere. Pădurile și sectorul forestier trebuie să facă parte din scenariul bioeconomiei românești.

Domeniul forestier din România are o tradiție îndelungată în ceea ce privește implementarea principiilor de gestionare durabilă a pădurilor. Din punct de vedere istoric, punerea în aplicare a unei planificări riguroase și consecvente a administrării pădurilor a fost un model pentru aplicarea principiilor de multifuncționalitate. Astfel de principii au fost aplicate cu mult înainte de abordările moderne de gestionare a pădurilor privind integrarea serviciilor

[1]Pe baza celui mai recent Raport privind politica globală în domeniul bioeconomiei (IV) publicat în 2020: https://gbs2020.net/wp-content/uploads/2020/11/GBS-2020_Global-Bioeconomy-Policy-Report_IV_web.pdf

ecosistemice oferite de păduri. Astfel, principiul multifuncționalității a asigurat furnizarea de servicii ecosistemice forestiere, nu numai din perspectiva continuității producției de lemn, ci și din perspectiva funcțiilor de protecție, a valorilor recreative și a diversității biologice. Timp de zeci de ani, aceste principii au sprijinit conservarea ecosistemelor, nu numai în cadrul ariilor protejate, ci în toate zonele împădurite ale țării.

Ultimii 30 de ani au adus provocări importante pentru sectorul forestier, cum sunt restituirea dreptului de proprietate asupra pădurilor, privatizarea industriei și diversificarea administrației pădurilor care nu sunt în proprietatea statului. În prezent, există o presiune politică și publică din ce în ce mai mare, care contestă sustenabilitatea practicilor de gestionare a pădurilor, cu accent special pe tăieri ilegale și gestionarea pădurilor în arii naturale protejate. În acest context, noua paradigmă a bioeconomiei ar trebui să pună accentul pe o abordare incluzivă din punct de vedere social, care să recunoască și să mobilizeze întregul spectru de servicii ecosistemice furnizate de pădurile românești. Aceasta ar trebui să promoveze o bioeconomie bazată pe gestionare durabilă și ecosisteme forestiere stabile. Ar trebui să încurajeze și să sprijine colaborarea intersectorială pentru a elibera potențialul creativ neutilizat și pentru a declanșa sinergii în vederea dezvoltării și ramificării lanțurilor de aprovizionare existente, a creării unora noi și a diversificării gamei de produse și servicii furnizate de păduri. Ar trebui să fie o viziune creată în comun de profesioniștii din domeniul forestier, de organizațiile societății civile și de publicul larg, printr-un proces bazat pe incluziune și transparență. Pentru aceasta, sunt necesare eforturi intelectuale, politice și economice substanțiale, atât din partea Guvernului României, cât și din partea Comisiei Europene.

Este însă important de menționat că, deși este esențial ca factorii de decizie politică și practicienii să adopte o abordare comună a politicii în domeniul bioeconomiei, bioeconomia nu este o soluție universală (bună pentru orice), și nici un „glonț de argint" care poate rezolva toate problemele noastre de sustenabilitate. Este doar un instrument în ceea ce ar trebui să fie o trusă de unelte, cu abordări și soluții diverse. Și, așa cum „legea instrumentului" a lui Maslow ne avertizează împotriva dependenței excesive de un instrument preferat, la fel și bioeconomia trebuie să evite soluțiile care își au rădăcinile în concepte prea simplificate, de substituire și de creștere verde neîntreruptă.

Bioeconomia trebuie să fie contextualizată și adaptată la realitățile socio-ecologice naționale. Ea trebuie să facă un bilanț al expertizei, pieței și infrastructurii tehnologice existente și să le reînnoiască într-un proces continuu de distrugere creativă. Mai precis, bioeconomia românească bazată pe păduri trebuie să se sprijine pe trei piloni, cu multiple fațete: (i) o abordare integrată, (ii) o cultură a inovării și (iii) o guvernanță pe mai multe niveluri.

Mai jos, sintetizăm principalele mesaje-cheie din fiecare dintre acești trei piloni:

I. SĂ SPRIJINE O ABORDARE INTEGRATĂ

Gestionarea pădurilor și conservarea naturii nu sunt antagoniste. Gestionarea integrată a pădurilor poate contribui la reconcilierea și atingerea unor compromisuri critice între obiectivele gestionării pădurilor, cum ar fi conservarea naturii și producția de biomasă. Pădurile României, cu diversitatea lor biologică unică și cu rezervele mari de lemn, oferă condițiile necesare pentru această abordare integrată. De fapt, nivelul exploatării anuale a lemnului din pădurile românești este mult mai mic atât față de creșterea anuală totală cât și de posibilitatea anuală aprobată la nivel guvernamental.

De asemenea, datele prezentate in acest volum arată că stocul de carbon din produsele lemnoase din România s-ar dubla în următorii 40 de ani, ajungând la aproximativ 80 de milioane MtC. Recoltarea acestei biomase va fi importantă pentru susținerea bioeconomiei. Prin aplicarea conceptului de **silvicultură inteligentă din punct de vedere climatic**, rolul important al pădurilor în atenuarea schimbărilor climatice poate fi sporit. Dar acest lucru nu trebuie să se facă cu prețul degradării biodiversității și a altor servicii ecosistemice. O abordare integrată trebuie să ia în considerare dinamica ecosistemelor forestiere, gestionarea pădurilor și diversele sale obiective, precum și alți factori, cum ar fi dinamica pieței, evoluțiile economice și demografice, schimbările socio-politice, inovațiile tehnologice și opinia publică. Pentru a se adapta la aceste cerințe în continuă schimbare, sectorul forestier românesc are nevoie de sprijin instituțional și financiar în trei domenii cheie:

- **MANAGEMENTUL FORESTIER**: Chiar dacă performanțele tehnice de gestionare a pădurilor au merite incontestabile, unele practici de management forestier trebuie reformate pentru a răspunde provocărilor socio-economice actuale. De exemplu, gestionarea pădurilor private și în special a celor de mici dimensiuni necesită soluții tehnice specifice bazate pe instrumente de sprijin și financiare diversificate. De asemenea, modul **de vânzare a masei lemnoase** trebuie să stimuleze valorificarea sortimentelor de lemn superioare care, la rândul lor, să vină în întâmpinarea cererii de produse lemnoase cu valoare adăugată ridicată; în același timp, sistemul de vânzare trebuie să urmărească principiul potrivit căruia controlul trebuie focalizat doar pe introducere pentru prima dată pe piață a lemnului, pentru a asigura o trasabilitate eficientă. Potențialul economic al altor **servicii ecosistemice**, cum ar fi turismul, recreerea și produsele nelemnoase, trebuie identificat și inclus în planurile de management, deoarece acestea fac parte integrantă din bioeconomia durabilă. Tot aici, sunt necesare **subvenții și compensații** pentru a permite o punere în aplicare adecvată a celor mai bune practici de conservare a biodiversității, pe suprafețe forestiere foarte mari și bine conectate, și pentru o producție eficientă și durabilă a altor servicii ecosistemice.
- **INFRASTRUCTURĂ ȘI TEHNOLOGIE**: investițiile în dezvoltarea infrastructurilor (de acces și informațională) și a tehnologiilor sunt esențiale. Acestea pot include investiții în tehnologii moderne, mai prietenoase cu mediul, pentru recoltarea și prelucrarea lemnului, dar și în extinderea infrastructurilor industriale existente, pentru a crea produse pe bază de lemn cu valoare adăugată mai mare. Acest lucru ar permite optimizarea utilizării în cascadă a lemnului și dezvoltarea **economiei circulare durabile**. Cu toate acestea, în pofida unei creșteri promițătoare a industriilor românești de prelucrare a lemnului (cherestele și panouri pe bază de lemn), principala tendință în ceea ce privește producția, exportul și consumul după anul 2015 este de stagnare și declin, în timp ce importurile pentru majoritatea produselor din hârtie și lemn sunt în creștere. Această tendință trebuie inversată prin **promovarea colaborării intersectoriale și a integrării verticale a lanțurilor valorice** care includ produse pe bază de lemn cu valoare adăugată ridicată, prin intermediul stimulentelor de piață și al subvențiilor. Provocările legate de resurse și de interesele sectoriale conflictuale trebuie abordate prin intermediul unei **coordonări politice intersectoriale active**.
- **DATE ȘI MONITORIZARE**: o abordare integrată a gestionării pădurilor nu poate fi realizată fără date fiabile și accesibile publicului larg. Datele și informațiile exacte joacă, de asemenea, un rol extrem de important în reducerea neîncrederii publicului

față de gestionarea pădurilor. În ciuda faptului că diferite instituții culeg nenumărate date, în prezent, în România nu există o bază de date unitară și cuprinzătoare, bazată pe instrumente de monitorizare eficiente pentru păduri și silvicultură. De exemplu, se resimte lipsa unor **informații robuste și coerente privind recoltele de lemn**, ceea ce împiedică evaluarea impactului pe care fondul de producție și produsele lemnoase îl au asupra stocului de carbon fixat din atmosferă. Pentru a combate activitățile ilicite și pentru a facilita **o monitorizare transparentă** și o verificare în timp real a transporturilor de lemn, sistemul electronic de trasabilitate a lemnului (SUMAL) trebuie să fie adaptat și perfecționat în continuare, prin integrarea unei soluții inovatoare: „**amprenta digitală**" a transporturilor de lemn. Sunt necesari indicatori specifici pentru a monitoriza în mod transparent eficiența implementării instrumentelor de politică forestieră, ce acoperă multiplele impacturi ecologice, sociale și economice ale bioeconomiei forestiere. Colectarea și analiza datelor trebuie să fie armonizate și puse la dispoziția părților interesate (mediul academic, organizațiile sociale, publicul larg etc.). Acest lucru trebuie să meargă dincolo de un proiect de inventariere sau de o bază de date, trebuind să evolueze într-o **platformă vie, deschisă pentru dezbateri și negocieri.**

II. SĂ GENEREZE ȘI SĂ SUSȚINĂ O CULTURĂ A INOVĂRII

Sectorul forestier românesc – dar și cel european, deopotrivă - trece printr-un proces de distrugere creativă. Acest lucru înseamnă că unele activități sau sectoare economice se reduc și dispar în mod inevitabil, în timp ce noi tehnologii, produse și modele de afaceri vor apărea în cele din urmă în locul lor. Este nevoie de o **politică de inovare orientată spre viitor**, pentru a naviga în acest proces tumultuos de mutație industrială. O astfel de politică de inovare trebuie să se bazeze pe trei piloni suplimentari:

- **FOLOSIREA FERESTREI DE OPORTUNITATE** deschisă de paradigma bioeconomiei. Industriile forestiere din Europa se confruntă cu schimbări structurale pe pieţele globale. Astfel de reverberații sunt resimțite în special în țări precum România, unde sectorul forestier se bazează încă pe modele de afaceri și piețe tradiționale. Deşi mecanismele bazate pe piață, cum ar fi **certificarea** gestionării pădurilor și a lanțului de custodie, sprijină companiile românești pe piețele naționale și internaționale, sunt necesare stimulente suplimentare. Pe măsură ce apar evoluții structurale mai ample (de exemplu, schimbări climatice, crize economice, schimbări în societate), apar așa-numitele „ferestre de oportunitate" care pot permite o difuzare pe scară largă a **inovațiilor de nișă**. Prin revitalizarea sectorului și conversia infrastructurii existente, pot fi generate venituri suplimentare semnificative, precum și **noi portofolii de produse**. De exemplu, utilizarea ligninei ca materie primă în industria chimică poate fi folosită pentru a produce agenți tensioactivi, lianți, dispersanți, aditivi pentru beton, diverse rășini și spume, precum și fibre de carbon. Prin utilizarea diferitelor tipuri de fibre disponibile în pădurile românești, se pot crea noi lanțuri de aprovizionare și sinergii cu industria textilă, farmaceutică și chiar cu industria constructoare de automobile. Avantajul managementului forestier cu obiective de producție pe cicluri lungi are deja ca rezultat un lemn de înaltă calitate, care oferă un potențial fără precedent de investiții suplimentare pentru **consolidarea sectoarelor mobilei și construcțiilor din lemn**.

- **CAPITAL SOCIAL**: Inovațiile nu sunt doar de natură tehnologică. De asemenea, inovațiile nu trebuie să provină doar din industrii consacrate și companii multinaționale. Generate de inițiative la nivel local, de ONG-uri sau de programe de sprijin guvernamental, pot oferi oportunități de consolidare a **capitalului social local** care, la rândul său, poate genera produse și servicii inovatoare. Acest lucru poate fi realizat prin sprijinirea activă a dezvoltării **antreprenoriatului social** în domenii precum agricultura la scară mică, gestionarea pădurilor și serviciile ecosistemice. Crearea unei organizații care să servească drept „**broker de inovare**" între factorii de decizie politică, finanțatori și antreprenorii locali va contribui la dezvoltarea în continuare a antreprenoriatului social regional, atât de necesar.
- **CERCETARE, DEZVOLTARE ȘI EDUCAȚIE**: Toate aceste inovații, fie ele tehnice sau sociale, nu se pot dezvolta fără un sprijin financiar și instituțional adecvat. Deși oportunitățile de a profita de **fondurile naționale și comune ale Uniunii Europene pentru cercetare și dezvoltare** sunt multiple, România nu a obținut încă finanțări importante pentru proiecte de cercetare într-un domeniu legat de bioeconomie, în cadrul **apelurilor Horizon**. Un alt potențial neexploatat pentru cercetarea în domeniul bioeconomiei legate de silvicultură este **BIOEAST** - „Central-Eastern European Initiative for Knowledge-based Agriculture, Aquaculture and Forestry in the Bioeconomy". În cele din urmă, finanțarea națională ar trebui să joace un rol mai important în sprijinirea activităților de cercetare și de transfer în domeniul forestier. De exemplu, Planul Național de Cercetare, Dezvoltare și Inovare pentru perioada 2015-2020 (PNCDI III) adoptat prin Hotărârea de Guvern 583/2015 avansează bioeconomia ca domeniu prioritar de specializare inteligentă, alături de tehnologia informațiilor și comunicațiilor, schimbări climatice și nanotehnologii. **Universitățile și institutele de cercetare** au nevoie de o îndrumare și o pregătire adecvată pentru a accesa acest tip de sprijin financiar. **Încurajarea învățării transformative** pentru a dota următoarea generație de profesioniști în bioeconomie cu setul de competențe și know-how adecvat trebuie să se afle în centrul educației forestiere academice din România.

III. SĂ ADOPTE O GUVERNANȚĂ PE MAI MULTE NIVELURI

România s-a confruntat cu schimbări instituționale și structurale importante ca parte a tranziției către economia de piață, cum ar fi **restituirea proprietății asupra pădurilor**, privatizarea sectorului forestier și **separarea instituțională** a funcțiilor de reglementare, control și gestionare a pădurilor. Acest lucru a dus la o **diversificare a părților interesate** și la o serie de **noi moduri de guvernanță**, cum ar fi: implementarea de standarde voluntare, reglementarea privată de către terți (certificare), eforturi comune între companii și organizații neguvernamentale etc. Cu toate acestea, sistemul politic tradițional, puternic reglementat, bazat în mare parte pe instrumente de comandă și control, prevalează încă, împiedicând buna guvernanță și sufocând potențialul României de a dezvolta o bioeconomie durabilă și favorabilă incluziunii sociale. Politica românească trebuie să adopte noi mecanisme de guvernanță care să ia în calcul:

- **CONTEXTE POLITICE INTERNAȚIONALE**: Sectorul forestier românesc este direct afectat de numeroase directive, regulamente și instrumente de politică ale Uniunii Europene. De exemplu, Comisia Europeană a prezentat mai multe instrumente

de politică și propuneri de reglementare care ar putea schimba regulile jocului, cum ar fi **noua strategie forestieră a UE, strategia UE privind biodiversitatea** sau **strategia actualizată privind bioeconomia.** De asemenea, Comisia a adoptat în 2020 noul **Plan de acțiune privind economia circulară**, ca unul dintre principalele elemente constitutive ale **„Pactului Verde" european**. În acest context, factorii de decizie din România trebuie să adopte aceste strategii, asigurându-se în același timp că **le adaptează la realitățile socio-ecologice și economice locale**. O strategie coerentă a UE în domeniul bioeconomiei, fundamentată pe strategii naționale, contextualizate la nivel local, poate consolida efortul european de tranziție către o bio-societate durabilă.

- **SCHIMBAREA PROPRIETĂȚII FORESTIERE**: Restituirea pădurilor în România a dus la o schimbare majoră a tiparelor de proprietate forestieră, 52% din suprafața forestieră fiind transferată în ultimii 30 de ani către proprietari de păduri, alții decât Statul român. Drepturile de proprietate ale proprietarilor de păduri din România sunt printre cele mai restricționate din toate țările europene, ceea ce afectează viabilitatea financiară a gestionării pădurilor pentru micii proprietari de păduri. Pentru a răspunde acestei realități, este **necesară reformarea abordărilor de comandă și control**, deoarece acestea nu au reușit să răspundă nevoilor financiare ale micilor proprietăți forestiere, au împiedicat gestionarea eficientă a pădurilor și, în cele din urmă, au limitat inovarea. Strategia privind bioeconomia trebuie să fie considerată ca un vector de sprijin a **noilor modele de guvernanță**, necesare pentru a asigura viabilitatea financiară a gestionării pădurilor. Trebuie să se recunoască diversitatea, caracteristicile și interesele diferiților proprietari de păduri. Dialogul structurat între părțile interesate, inițiat în 2020[2], trebuie să asigure transparența, responsabilitatea, legitimitatea și procesul participativ de elaborare a politicilor, ceea ce ar putea contribui, în cele din urmă, la **reformarea politicii forestiere românești**.
- **PROVOCĂRILE ȘI OPORTUNITĂȚILE REALITĂȚILOR ZONEI RURALE**: O mare parte a cetățenilor români (44%) trăiesc în mediul rural. În mare măsură, majoritatea gospodăriilor rurale utilizează în mod tradițional produsele și serviciile pădurii pentru a-și asigura mijloacele de subzistență. Modul tradițional de gestionare a terenurilor a creat și menținut situații foarte diverse, fiind un model de succes al coexistenței cu natura. Cu toate acestea, viața în mediul rural românesc este dură, rata șomajului este ridicată și, în unele cazuri, accesul la educație este limitat. Prin urmare, există o tendință clară a populației de a părăsi satele pentru zonele urbane sau de a emigra în străinătate. Este necesar să se identifice punctele de sprijin pentru dezvoltarea rurală. Acestea, pe lângă alți parametri de dezvoltare, ar trebui să se concentreze atât pe valorile cât și pe intențiile comunității. De exemplu, pădurile joacă un rol crucial în asigurarea securității energetice a multor comunități. De asemenea, acestea oferă locuri de muncă în zonele rurale cu alternative limitate din partea altor sectoare. O strategie de dezvoltare rurală care se bazează pe ceea ce funcționează deja la nivel local, care valorifică inițiativele existente în materie de durabilitate și integrează eforturile practicienilor locali, are mai multe șanse să genereze schimbări în direcția unei bioeconomii durabile. În cele din urmă, bioeconomia trebuie să furnizeze infrastructura verde (servicii, instituții, oameni, transport, etc.) necesară pentru a crea

[2]www.optiuni.strategieforestiera.ro

oportunitățile de trecere de la exodul rural la dezvoltarea rurală. Din nou, sprijinul financiar orientat, promovarea inovării sociale și oferirea de oportunități educaționale adecvate pentru populația rurală săracă sunt căi importante pentru a inversa aceste tendințe negative.

Fără îndoială, sectorul forestier românesc este parte indispensabilă a tranziției durabile către bioeconomia circulară. Nu numai că acest sector poate contribui în mod semnificativ la transformarea întregului sistem socio-economic, dar poate juca un rol central în demersul nostru de a ne îndepărta de producția și consumul pe bază de combustibili fosili. Însă, pentru a-și atinge cu adevărat potențialul și pentru a se dezvolta pe deplin, dincolo de limitele sale actuale, sectorul forestier are nevoie de angajamente politice și financiare puternice. În rândurile de mai sus, am prezentat un „plan B" concret al modului în care acest lucru poate fi realizat - planul pentru bioeconomie.

EXECUTIVE SUMMARY

Forests are at the heart of a sustainable green transformation. By transitioning to a predominantly circular, bio-based economy, we can reduce our dependency on fossil-fuels and contribute to climate change mitigation, environmental protection, and societal cohesion. But despite admirable progress in forest governance reform, Romania has not yet truly embarked on the bioeconomy journey. Although the forest-based sector is, and will always be, a central pillar for the bioeconomy, new ways of thinking and acting are necessary if the bioeconomy transformation is to unfold. Such new ways of thinking are not only limited to new and improved ways of managing forests and conserving biodiversity, but also include new adaptive governance models, creative approaches to business and innovation, as well as a stronger focus on the equity and inclusion of the Romanian society for co-creating a truly sustainable future.

This book is a call for collective and integrated action to global leaders, investors, companies, scientists, governments, nongovernmental and intergovernmental organizations, funding agencies and the society at large to put Romania's forests on a sustainable path. This vision is put forward by Romanian and international experts whose exceptional work is pivotal in aiding our understanding of how the circular-bioeconomy transformation can unfold. This volume contains contributions from authors with diverse backgrounds: academics, practitioners, business people, and NGO representatives. It offers a variety of perspectives on the potential challenges and opportunities that a circular-bioeconomy may bring about. It presents a forward-looking, fact-based approach, rooted in science and firsthand experience. It presents the plan B for Romania's forests and society – the plan for a circular-bioeconomy.

No doubt, the bioeconomy narrative has taken a foothold in the European Union and in many countries around the world. So far, significant investments in technology, research and innovation have been mobilized. At the time of writing, almost 60 countries around the world are pursuing bioeconomy-related policies[3]. So far, Romania does not have such a national bioeconomy strategy. But the time is ripe for embracing the bioeconomy narrative, especially considering that the Romanian Government is in the midst of reviewing its national forest strategy. Forests, and the forest-based sector need to be part of the Romanian bioeconomy narrative.

Romanian forest professionals have extensive experience in implementing sustainable forest management principles. Historically, the implementation of a rigorous and consistent forest management planning has been a model for the application of multi-functionality principles. Such principles were applied long before the implementation of modern governance approaches for integrating ecosystem services. The multi-functionality principle had secured the provision of forest ecosystem services, not only from the perspective of the sustained-yield principle, but also from the perspective of regulatory functions, recreational values, and biological diversity. For decades, these principles have supported the preservation of close-to-nature ecosystems, not only within protected areas, but across the country's entire forested landscapes.

The last 30 years have brought important challenges for the forest sector resulting e.g. from

[3]Based on the latest Global Bioeconomy Policy Report (IV) published in 2020: https://gbs2020.net/wp-content/uploads/2020/11/GBS-2020_Global-Bioeconomy-Policy-Report_IV_web.pdf

the restitution of forestlands, privatization of forest industry and of the forest administration. Currently, there is mounting political and public pressure challenging the application of forest management practices, especially with regards to the lack of law enforcement and the management of protected areas. In this context, the bioeconomy narrative should emphasize a socially inclusive bioeconomy that acknowledges and mobilizes the entire spectrum of ecosystem services provided by Romanian forests. It should promote a bioeconomy that is driven by sustainable forest management and healthy ecosystems. It should encourage and support cross-sectoral collaboration in order to unleash untapped potentials and ignite synergies for further developing and branching out the existing supply chains; it should create new supply chains and diversify product portfolios. It should be a narrative that is co-created by forestry professionals, societal organizations, and the broader public. In this respect, it should be a narrative that builds on inclusiveness and transparency. For this, substantial intellectual, political, and economic investments are needed, both from the Romanian Government and from the European Commission.

Although it is crucial that policymakers and practitioners adopt a common bioeconomy policy narrative, it goes without saying that the bioeconomy is no "one size fits all", nor is it a "silver bullet" that can address all of our sustainability problems. It is but a tool in what should otherwise be a diverse toolbox of approaches. And just as Maslow's "law of instrument" warns us against the over-reliance on a favorite tool, so too must the bioeconomy avoid solutions rooted in oversimplified narratives of substitution and unabated green growth. The bioeconomy needs to be contextualized and adapted to national socio-ecological realities. It needs to take stock of the existing expertise, markets and technological infrastructure, and renew these in a continuous process of Schumpeterian creative destruction. More specifically, the Romanian forest-based bioeconomy narrative needs to build on three multifaceted pillars: (i) an integrated approach (ii) a culture of innovation; and (iii) a multi-layered governance. Below, we summarize the main key messages from each of these three pillars:

I. SUPPORT AN INTEGRATED APPROACH

Forest management and nature conservation are not antagonistic. Integrated forest management can help reconcile critical trade-offs between goals in forest management, such as nature conservation and biomass production. Romania's forests, with their unique biological diversity and high timber stocks, offer the necessary preconditions for this integrated approach. In fact, the level of annual wood removal in Romanian forests is much lower than both the annual allowable cut and total current annual growth. The Carbon stock in Romania's wood products would also double in the following 40 years, reaching as high as 80 million MtC. Harvesting this biomass will be important for sustaining the bioeconomy. By applying the concept of **climate smart forestry**, the important role of forests in mitigating climate change can be increased. But this must not come at the cost of biodiversity degradation and other ecosystem services. An integrated approach must take into consideration forest ecosystem dynamics, forest management and its diverse objectives as well as other factors such as market dynamics, economic and demographic developments, socio-political changes, technology innovation and public opinion. In order to adapt to such ever-changing demands, the Romanian forest-based sector needs institutional and financial support in three key areas:

- **FOREST MANAGEMENT**: despite all their merits, some forest management practices need to be reformed. For example, **shifting from a stumpage sales system**

to a system based on distinctly converted wood assortments, when first placed on the market, would ensure efficient use of resources as well as support the creation of high value-added bio-based products. Other **ecosystem services** such as tourism, recreation and non-timber products need to be included in management plans as they are integral parts of the sustainable bioeconomy. Here, **subsidies and compensations** are necessary to enable a proper implementation of best practices for biodiversity conservation across very large and well-connected forested landscapes and for the efficient and sustainable production of other ecosystem services.

- **INFRASTRUCTURE AND TECHNOLOGY**: investments in infrastructural and technological developments are crucial. These may include investments in modern, more environmentally friendly, technologies for wood harvesting and processing, but also in expanding existing industrial infrastructures to create higher value-added wood-based products. This would enable the optimization of the use of wood according to the **cascading principle** and **sustainable circular economy**. However, despite a promising growth of Romanian woodworking industries (sawnwood, and wood-based panels) the main trend in the production, export, and consumption after 2015 is stagnation and decline, while imports for most paper and wood products are growing. This trend needs to be reversed by **promoting cross-sectoral collaboration and vertical integration of value chains** that include high value-added wood-based products through market incentives and subsidies. Challenges related to siloes and conflicting sectorial interests must be addressed through **active cross-sectoral policy coordination**.
- **DATA AND MONITORING**: an integrated approach to forest management cannot be achieved without reliable, open data. Accurate data and information also play a tremendous role in reducing the public mistrust in forest management. At present, there is a fragmented landscape of forest-related data and monitoring instruments in Romania. For example, there is a lack of **robust data on timber harvests** which hinders the assessment of the actual atmospheric impact of the wood products pool. To tackle illicit activities, and to facilitate **a transparent monitoring** and real-time verification on wood transports, the electronic wood traceability system (SUMAL) needs to be adapted and further refined by integrating an innovative solution - the "**digital footprint**" of wood transports. **Specific indicators** are needed to transparently monitor the efficiency of the implementation of the policy instruments covering the multiple ecological, social, and economic impacts of the forest-based bioeconomy. Data acquisition and assessment needs to be harmonized and made freely available to interested parties (academics, societal organizations, the public etc.). This has to go beyond an inventory design or a database, but has to serve as **an open platform for debate and negotiation** that serves as a living knowledge base.

II. NURTURE A CULTURE OF INNOVATION

The Romanian – and the European – forest-based sector is undergoing a process of creative destruction. This means that some economic activities or sectors inevitably decline and vanish, whereas new technologies, products and business models will eventually emerge in their place.

A forward-looking innovation policy is needed in order to navigate this tumultuous process of industrial mutation. Such an innovation policy must build on three additional pillars:

- **WINDOWS OF OPPORTUNITY**: Forest-based industries in Europe are facing structural changes in global markets. Such reverberations are particularly felt in countries such as Romania, where the forest-based sector still relies on traditional business models and markets. Although, **market-based mechanisms** such as forest management- and chain of custody **certification** are supporting Romanian companies on the national and international markets, additional incentives are needed. As broader structural developments occur (e.g., climate change, economic crises, societal changes) so called "windows of opportunity" emerge that may allow for a wide-scale diffusion of **niche innovations**. By revitalizing the sector and converting the existing infrastructure, significant additional revenues, as well as **new product portfolios**, can be generated. For example, lignin currently used as a feedstock in the chemical industry can be used to produce surfactants, binders, dispersants, concrete admixtures, various resins and foams as well as carbon fibers. By using different types of fibers available in Romanian forests, new supply chains and synergies can be created with the textile-, pharmaceutical- and even the car manufacturing industries. The existing advantage of long rotation production goals already results in high quality timber which offers an unprecedented potential of further investments to **strengthen the furniture- and timber construction-sectors**.
- **SOCIAL CAPITAL**: Innovations are not only of technological nature. Nor must innovations solely come from established industries and multinational companies. **Social innovations** spearheaded by grassroots initiatives, NGOs- or governmental support programs can provide opportunities for strengthening **local social capital** which in turn may generate innovative products and services. This can be achieved by actively supporting the development of **social entrepreneurship** in areas such as small-scale farming, forest management and ecosystem services. Creating an organization that serves as an "**innovation broker**" between policymakers, funders and local entrepreneurs will help to further develop the much needed regional, social entrepreneurship.
- **RESEARCH, DEVELOPMENT AND EDUCATION**: All these innovations, whether technical or social, cannot flourish without adequate financial and institutional support. Luckily, the opportunities for tapping into the national and common European Union funding pool for research and development are manifold. For example, Romanian universities need to access large research-funding in a forestry-related subject under **Horizon calls**. Another untapped potential for forestry-related bioeconomy research is **BIOEAST** – "Central-Eastern European Initiative for Knowledge-based Agriculture, Aquaculture and Forestry in the Bioeconomy". Lastly, national funding should play a more central role in supporting forest-based research and transfer activities. For example, the National Plan for Research, Development and Innovation for 2015-2020 (PNCDI III) adopted through Governmental Decision 583/2015 puts forward the bioeconomy as a priority area for smart specialization, next to information and communication technology, climate change and, nano-technologies. **Universities and research institutions** need adequate guidance and coaching to access this type of financial support. Last but not least, **fostering transformative learning** to equip the next generation of bioeconomy professionals with the adequate skillset and knowhow must be at the heart of academic forestry education in Romania.

III. ADOPT MULTI-LAYERED GOVERNANCE

Romania has faced important institutional and structural changes as part of the transition to the market economy such as **the restitution of forest ownership**, the **privatization** of the forest-based sector and the institutional separation of the regulatory, control and forest management functions. This has resulted in a **diversification of stakeholders** and a series of **new modes of governance** such as: self-regulation, third-party private regulation (certification), joint efforts between companies and non-governmental organizations etc. Yet, the traditional, heavily regulated policy system largely based on command-and-control instruments still prevails, hindering good governance and stifling Romania's potential to develop a sustainable and socially inclusive bioeconomy. New governance mechanisms need to recognize:

- **INTERNATIONAL POLICY CONTEXTS**: The Romanian forest-based sector is directly affected by many European Union directives, regulations, and policy tools. For example, the European Commission has been rolling out several potentially game-changing policy instruments and regulatory proposals such as the new **EU Forest Strategy**, the **EU Biodiversity Strategy**, or the updated **Bioeconomy Strategy**. The Commission has recently also adopted the new **Circular Economy Action Plan** in 2020 as one of the main building blocks of the **European Green Deal**. In this context, Romanian policymakers must adopt these strategies while making sure to **adapt them to local socio-ecological and economic realities**. A coherent EU Bioeconomy Strategy, grounded in national, locally-contextualized strategies can strengthen the European endeavor of transitioning to a sustainable bio-society.
- **CHANGING FOREST OWNERSHIP**: Forest restitution in Romania resulted in a major change in the forest ownership patterns with 52% of the forest area being transferred to non-state forest owners in the last 30 years. The property rights of Romanian forest owners are among the most restricted across European countries hindering the financial viability of the forest management for small-scale forest owners. In order to respond to this reality, **command and control approaches need to be reformed** as they have failed to address the financial needs of small-scale forest properties, hindered efficient forest management and ultimately constrained innovation. The bioeconomy strategy must be considered as a vector to support **new governance models** needed to assure the financial viability of forest management. The diversity, characteristics and interests of different forest owners need to be acknowledged. The **structured dialogue** between stakeholders which started in 2020[4] needs to assure the transparency, accountability, legitimacy and participatory policymaking which may ultimately contribute to reforming Romanian forest policy.
- **THE CHALLENGES AND OPORTUNITIES OF RURAL REALITIES**: a large share of Romanian citizens (44%) are living in rural areas. To a large extent, most of the rural households traditionally use the products and services of the forest for their livelihoods. The traditional way of managing land has created and maintained very diverse landscapes, a model for successful coexistence with nature. However, the Romanian rural environment is harsh, the unemployment rate in the rural areas is high and, in some cases, the access to education is limited. Therefore, there is a clear

[4]www.optiuni.strategieforestiera.ro

tendency of the population to leave villages for urban areas or to emigrate abroad. **Leverage points for rural development** need to be identified. These should focus on both community values and intent, in addition to targeting other development parameters. For example, forests play a crucial role in ensuring the energy security of many communities. They also provide jobs in rural areas with limited job alternatives. A rural development strategy that builds on what already works locally, that capitalizes on existing sustainability initiatives and integrates the efforts of local practitioners, is more likely to generate change towards a sustainable bioeconomy. Ultimately, the bioeconomy needs to provide the **necessary green infrastructure** (social, transport, people, institutions, services) to create the opportunities needed for switching tracks from rural exodus to rural development. Again, targeted financial support, fostering social innovation, and providing adequate education opportunities for the rural poor are important avenues for reversing these negative trends.

Undoubtedly, the Romanian forest-based sector is an indispensable part of the sustainable circular -bioeconomy. Not only can this sector significantly contribute to the transformation of the entire socio-economic system, but it can also play a central role in our quest to move away from fossil-based production and consumption. But to truly unfold its potential and fully flourish beyond its current limitations, the forest-based sector needs strong political and financial commitments. In the lines above, we have presented a concrete "plan B" for how this can be achieved – the plan for bioeconomy.

INTRODUCTION

Alexandru Giurcă

Old wine in new bottles?

Forests, and the communities relying upon them, are intrinsically connected with a traditional form of bioeconomy, as they have been for millennia. Wood has played an important role in the history of civilization. Humans have used it for fuel, building materials, furniture, tools, weapons, and more (D`Costa 2015). Apart from wood for materials and shelter, forests have provided us with nourishment in the form of wild berries, fruits, mushrooms, and game. They have also provided us with various ecosystem services such as recreation, cultural services, or the increasingly recognized forest health, the so-called "forest bathing" (Shinrin-yoku) coined by the Japanese forester Akiyama (Miyazaki 2021). If the bioeconomy narrative pertains to a new way of human-nature interaction, this new way is really "back to the future" in essence, or an idealistic return to humanity's forgotten roots.

The concept of sustainable forest management has also been around for centuries. The first comprehensive treaty on sustainable forestry was penned by Hans Carl von Carlowitz in his seminal Sylvicultura oeconomica, more than 300 years ago (Carlowitz 1713). Referring to this long tradition of practicing sustainable management, a Hessian media campaign from 2013 came up with the following tongue-in-cheek statement to celebrate 300 years of sustainable forest management in Germany: "You think sustainability is modern? We do too - for 300 years." The statement was followed by another memorable adage "Forestry in Germany - forward-looking by tradition" (DFWR 2014).

There is obviously a strong sense of identity that foresters associate with their work and expertise, and this goes well beyond Germany's borders. The collective identity of foresters makes them guardians of sustainable management in forestry (Lehmbruch and Lehmbruch 2012) and there seems to be a broad consensus among foresters that their work is primarily aimed at maintaining forests healthy (Hengst-Ehrhart and Schraml 2020). But this picture is challenged from both within and outside the forest sector which has increasingly come under public and political pressure (Buijs and Lawrence 2013; Lawrence 2009).

The new bioeconomy narrative too seems to challenge the picture of traditional forest management and risks to exacerbate conflicts around this contested green resource. The Schumpeterian concept of "creative destruction" – a process of industrial mutation in which old industries vanish and new ones take their place – seems apt to describe the tumultuous change brewing under the surface (Hetemäki 2014). In its newest interpretation, the bioeconomy narrative moves away from its initial, sufficiency-based philosophy envisioned by Georgescu-Roegen (Georgescu-Roegen1975; Georgescu-Roegen 1978), and, instead, it imagines an economy where biomass replaces fossil fuels and mining to produce energy and materials (Vivien et al. 2019). This new, growth-oriented bioeconomy narrative, which is perhaps too focused on substitution and technological fixes, was criticized by scholars for its weak sustainability approach (Ramcilovic-Suominen and Pülzl 2017; Vivien et al. 2019).

Indeed, the bioeconomy is not sustainable per se. Nor are all practices of the forest-based sector. In fact, the sustainability concept has undergone many iterations. Carlowitz's

original sustainability concept was borrowed, adopted, and expanded under the historic Brundtland Report published in October 1987 by the United Nations (United Nations 1987). The report recognizes that human resource development in the form of poverty reduction, gender equity, and wealth redistribution is crucial to formulating strategies for environmental management and conservation. But an important syntactical and philosophical distinction needs to be made here: whereas 'sustainability' is generally thought to represent a long-term goal, 'sustainable development' usually refers to the means or the process by which to achieve it (Hector et al. 2014). There are seventeen sustainable development goals, ranging from zero hunger to responsible consumption, climate action, and life on land.[5] The bioeconomy is not a "silver bullet" capable to address all sustainability issues. It could be, however, a means to achieve sustainable development, as it can successfully address some, but not all, sustainable development goals (Ronzon and Sanjuán 2020).

Forests and the forest-based sector play a crucial role in achieving some of these goals (Baumgartner 2019). Yet, despite their potential, it is surprising that the importance of the sector was not properly acknowledged in the initial iteration of the bioeconomy strategy (Ollikainen 2014), albeit, arguably, this shortcoming has been addressed by the revised 2018 strategy (European Commission 2018). Nevertheless, forest stakeholders still point to a lack of clear policy guidance and many feel that the forest-based sector has not yet been adequately involved in bioeconomy deliberations (Giurcă 2020; Navrátilová et al. 2021). In many bioeconomy clusters outside the Nordic countries, where the forest sector is actively steering, and even capturing the bioeconomy transformation (Holmgren et al. 2022), forest stakeholders are still marginal players (Giurcă and Metz 2018).

Seeing the people for the trees

One could claim that we are dealing with two conflicting narratives around the bioeconomy. On the one hand, we have a traditional bioeconomy narrative that resonates with, and reinforces the belief of forestry professionals that the forest-based sector is synonymous with the bioeconomy (Hodge et al. 2017; Stein et al. 2018). According to this narrative, forests are, and will always be a part of the bioeconomy simply because the traditional know-how of managing this green gold was passed on from generation to generation of foresters. After all, foresters pride themselves in having first operationalized the concept of sustainability. On the other hand, we are seeing a new bioeconomy narrative promoted by the European Commission. This new narrative seems to detach resources and lands from their traditional stewards and focuses instead on technical aspects such as optimizing supply chains, incentivizing technological innovations, and thereby aiming to create new wood-based products and drop-in innovations (Befort 2021) (e.g., surfactants, binders, dispersants, carbon fibers, etc.) alongside the already existing ones (pulp and paper, construction wood, sawlogs, pellets, etc.). This narrative also operationalizes sustainability in a rather utilitarian way and has therefore been criticized for downplaying environmental concerns (Kleinschmit et al. 2017), for failing to engage in broader societal deliberations (Mustalahti 2017), and for neglecting an inclusive innovation that will not affect forest-dependent communities (Bryden et al. 2017).

As a result, both the forest-based sector's and the European Commission's bioeconomy narratives of a sustainable future are being increasingly contested by societal organizations and

[5]The 17 Sustainable Development Goals: https://sdgs.un.org/goals

the broader public. There is growing public distrust in both forestry practices and the foresters' ability to cope with challenges such as climate change and biodiversity loss. Pursuing a growth-oriented bioeconomy strategy based on forestry resources raises a multitude of additional questions about wood availability and the potential for increased conflicts around wood use (Jonsson et al. 2021). An expert we once interviewed for a study on bioeconomy perceptions came up with the humorous analogy of a "bioeconomy arena" i.e., an increasingly intensifying conflict between the different forest-based sectors. One can imagine this arena as a ring in which the different sectors are ready to wrestle for their fair share of wood, while the public cheers on, one part of the crowd railing for growing the economy, the other part demanding more sustainability.

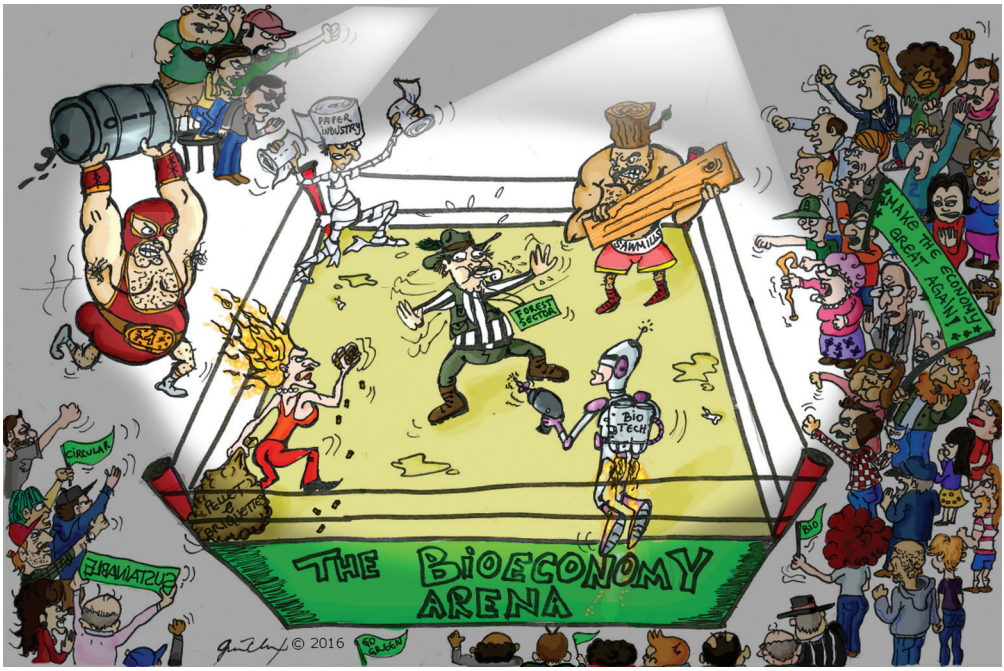

Figure 1.1 The Bioeconomy arena ©Alex Giurcă

But such conflicts and diverging expectations from forests are not new. Conflicts between utilitarian needs for wood and cultural values, aesthetics, recreation, and nature conservation have existed in Europe and around the world for centuries (Buijs and Lawrence 2013; Nousiainen and Mola-Yudego 2022). Memorable examples include the Spotted Owl conflict of the 1980s and 1990s caused by logging of old-growth forests in the Pacific Northwest of the US. More recent examples include protests against lignite mining operations threatening western Germany's ancient Hambach Forest. But such environmental protests are no longer reserved for western democracies. The expertise of foresters has, until recently, been relatively uncontested in eastern European forest management. Political, economic, and social changes are now challenging that (Lawrence 2009). In recent decades, protest movements for the environment have become more prominent in eastern Europe, which despite its heritage of socialist regimes, has gone through a profound political transformation increasingly pitting alienated and mistrustful citizens against their highly exclusive political systems (Spöri and

Jaitner 2016). Ongoing protests against logging in Poland's UNESCO-protected Białowieża forest, or the growing public uproar in Romania against illegal logging bear witness to this turbulent political transformation.

So far, the strategy of foresters, policymakers, and even some scientists, has been to frame such conflicts and critiques as mere rational differences related to diverging knowledge, values, and interests (Buijs and Lawrence 2013). Particularly in eastern Europe, the foresters' closely defended expertise shaped by half a century of centralized decision-making, comes with deep hostility to overregulation, and the influence of international agendas (Lawrence 2009). Media coverage, on the other hand, tends to favor the perspective of some actors over others (Park and Kleinschmit 2016). There is also growing evidence that these conflicts have increasingly moved beyond utilitarian and simplistic differences in stakeholder values. Conflict is not merely based on diverging views but it has become a dimension of engagement (Buijs and Lawrence 2013). Experts need to acknowledge that conflicts are based on emotional bonds with forests, trees, and nature. Such bonds can be interpreted as a sign of the public's emotional engagement with their natural environment. This is especially relevant, since many actors of the post-socialist forest management sector are deeply concerned about the fate of the forests in a consumer-driven economy (Lawrence 2009). As such, emotional attachment needs to be taken into account in forest policy and planning (Buijs and Lawrence 2013).

What is needed is a bioeconomy narrative that puts society at its core. Human emotions, attitudes, interests, and actions are critical for the entire forest-based value chain, from forest owner – to industrial operator – to bioeconomy entrepreneur – to forest-dependent communities – to urbanites expecting more conservation while at the same time demanding more forest-based products and services (Winkel 2017). This is not a call for indulging in the hysterical, "direct" form of democracy that Plato begrudgingly witnessed in ancient Athens, but rather an encouragement that distrust, moral outrage, and conflict should be seen as assets of modern pluralist democracies (Flyvbjerg 1998).

If there is one important lesson to be learned from the conflicts over forests, it is that merely ensuring the sustainability of resources is not enough. Sustainability requires that forest-, nature conservation- and bioeconomy- policies engage with the demands of the broader society in order to gain societal legitimacy. And this needs to go beyond merely sensitizing the public or creating public or consumer acceptance (Winkel 2017).

A forest-based bioeconomy for Romania

We cannot look to the future without learning from the past. An inclusive and forward-looking bioeconomy narrative needs to be able to seamlessly entwine the old with the new. Nowhere else in Europe does the old meet the new like in Romania, a country known for its stunning natural beauties and rich cultural traditions, yet at the same time undergoing rapid urbanization and economic growth. By its very nature, Romania provides a living lab where concepts of interdependent land use, locally adapted business models, and circular bioeconomy value webs relying on biological resources and nature-based systems can be tested. And forests and the people relying upon them are the bloodline of this mosaic of interdependent land uses.

The time is ripe for co-creating a bioeconomy narrative worthy of Romania's socioecological diversity. This is where this book comes in. The following chapters critically address the different facets of the sustainability concept (society, environment, and economy)

from the perspective of a forest-based bioeconomy contextualized to Romanian prerequisites and needs.

The core objectives of this book are threefold:

- Highlight the importance of forests and the forest-based sector in contributing to the national and European bioeconomy;
- Provide a fact-based assessment of a forest-based bioeconomy given innovation and economic, social, and environmental sustainability;
- Identify present and future challenges and opportunities that may affect the development of a forest-based bioeconomy.

These major objectives are addressed by the chapters of this book. These chapters have been co-authored by experts based at eleven institutions from seven different countries. The authors have diverse backgrounds: academics, practitioners, business people, and NGO representatives. They offer a variety of perspectives on the potential challenges and opportunities that a circular-bioeconomy may bring. We have grouped these different perspectives in three broad, interconnected parts:

I. Forest Management and Conservation

II. Innovation, Trade, and Business

III. Society, Policy, and Governance

Each part contains four to five chapters, as well as an "impulse", setting the stage for each section, and an "expert insight" sharing the perspectives of practitioners working at the frontline of bioeconomy development.

Part one (Forest Management and Conservation) opens with an impulse from Marc Palahí **(Impulse 1)** who makes a compelling case for placing nature at the center of the circular bioeconomy and thus for pursuing a new economic system that functions within the planetary boundaries. Valeriu-Norocel Nicolescu **(chapter 1.1)** then sets the stage by giving a comprehensive overview of Romanian forests and forestry, followed by a description of the main characteristics of the Romanian forest ecosystem as well as the current close-to-nature management approach. Petru Tudor Stăncioiu **(chapter 1.2)** homes in on the complex, and interdependent relationship between biodiversity conservation and forest management. He takes the reader on an enticing journey that outlines the basics of biodiversity conservation and shows that nature conservation and forest management are not antagonistic. Tackling climate change is the task of the century. Luckily, trees and forests offer the best carbon capture technology. In **chapter 1.3**, Viorel N. B. Blujdea attempts to answer the difficult question of how to balance forest management with wood-use for a climatically neutral economy. Radu Vlad **(chapter 1.4)** focuses on one specific practice – the stumpage sales system. He makes several compelling arguments for why this system is inefficient and provides a series of alternatives for vertical value chain integration and a circular approach that can help operators make more from less. In **chapter 1.5**, Bogdan Popa takes the discussion beyond woody biomass and argues that forest ecosystem services are an indispensable part of the bioeconomy, which should include other important conservation, recreational and cultural services. Part one ends with an insight from a practitioner, Costel Bucur, who shares his views on how nature conservation and forest management can be reconciled and thus build a resilient bioeconomy that can satisfy economic, social, and environmental demands.

Part two (Innovation, Trade, and Business) starts with an impulse from Doru-Leonard

Irimie **(Impulse 2)** who outlines the research and innovation funding opportunities at the European level. Irimie describes how Romanian researchers and practitioners can build better synergies and leverage these European funding opportunities to create impactful research and transferable innovations. Julia Wenger, Michael Kriechbaum, and Tobias Stern **(chapter 2.1)** then present some useful heuristics developed by innovation scholars, which professionals, academics, and policymakers can employ to better manage Romania's transition towards a forest-based bioeconomy. Alice Ludwig and Ada Diaconescu **(chapter 2.2)** remind us that innovation is not only of technical nature but that social innovation must play a central role in Romania's forest bioeconomy transformation. Marko Lovrić and Alexander Moiseyev zoom out in **chapter 2.3** and provide an overview of Romania's international timber trade networks and production and consumption patterns of wood-based products. They highlight some important trends in import and export data and describe both the growth and the worrying stagnation of some wood-based industries. Related to the domestic and international timber markets discussion, Aureliu-Florin Hălălișan and Marius Turtică **(chapter 2.4)** describe how market-based mechanisms such as sustainable forest management certification schemes have helped Romanian operators expand their domestic and international trade networks, as well as strengthen their sustainable management practices. Similarly, Antoanela Costea and Radu Vlad **(chapter 2.5)** present another set of sustainability criteria for the use of biomass for renewable energy and make some suggestions on how such criteria could be implemented. This section ends with an insight from our co-editor, Daniel-Paul Dima who gives examples of different sustainable business models that can help the Romanian forest-based sector unlock its potential. Dima looks at countries such as Finland and exemplifies some promising forest-bioeconomy business models.

Part three of this volume addresses the bioeconomy from a series of societal-, political-, and governance- perspectives. The section starts with an impulse from Filip Aggestam **(Impulse 3)** who reflects upon the role of Romanian forest policy in the EU context and highlights some of the most important recent policy developments such as the newly published EU forest strategy. In **chapter 3.1**, Liviu Nichiforel and Laura Bouriaud make a convincing argument for why Romanian forest policy needs to be reformed and show that a new constellation of stakeholders has resulted in the establishment of various types of governance mechanisms that need to be acknowledged. Liviu Nichiforel **(chapter 3.2)** then offers a detailed radiography of the ever-changing forest ownership landscape in Romania and pleads for a governance model that acknowledges the diversity, characteristics, and interests of forest owners. Similarly, Andra-Ioana Horcea-Milcu **(chapter 3.3)** talks about local stakeholders and highlights the importance of a rural development strategy that builds on what is already working locally, which capitalizes on existing sustainability initiatives and integrates the efforts of local practitioners. Finally, in **chapter 3.4**, Laura Bouriaud addresses what should be the bedrock of a just society: education. Bouriaud reflects upon how the Romanian forestry education system can be reformed in order to equip the next generation of bioeconomy professionals with the adequate skillset and know-how to creatively address increasingly complex interactions between humans and their natural environment.

Each of these chapters ends with a set of key messages, as well as a series of recommendations for action. We have summarized these latter points in the last chapter of this book, titled "The Way Forward", where we take stock of the lessons learned and sketch out a concrete plan for moving forward. But for now, we hope the reader will be inspired as she embarks on an enticing journey through the multifaceted and infinitely fascinating Romanian forest-bioeconomy.

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PART 1

FOREST MANAGEMENT

BIODIVERSITY CONSERVATION

IMPULSE 1: Placing Nature at the Center of a New Economy – a Circular Bioeconomy

Marc Palahí

An old system

After relying for more than 100 years on a linear fossil-based economy, we have arrived at a tipping point. The coronavirus pandemic, the biodiversity and climate crisis are different consequences of the same fundamental problem: our economic system. A system addicted to fossil resources and growth at all costs that has failed to value our most important capital: Nature.

The way forward is clear to many; we need a new economic system that functions within the planetary boundaries. How to transition towards it is the tricky part: it requires the most rapid economic transformation in human history to move towards a climate neutral, circular and inclusive economy that prospers in harmony with Nature. This paradigm shift requires **transformative** policies, mission-oriented innovation and massive investments in biobased solutions and natural capital, while rethinking business models and markets, as well as production and consumption cycles.

But, above all, we need to address the past failure of our economy to value nature, because our health and wellbeing fundamentally depend on it.

A new paradigm

A circular bioeconomy **(see Figure 1.2)** offers a conceptual framework for using renewable natural capital to holistically rethink our land, food, and health systems as the basis to transform industries and reimagine our cities to achieve sustainable wellbeing within ecological boundaries (Palahí et al. 2020). The advances of science and technology at the intersection of the biological, physical, and digital worlds, provide the circular bioeconomy with the innovation potential to replace the current fossil-based economy.

But while the circular bioeconomy needs advanced technology and innovation as well as traditional knowledge to succeed, it ultimately relies on **biodiversity** as its true engine. This is because biodiversity is a prerequisite for life to adapt and evolve in a changing environment, and a **bioeconomy** is above all an economy powered by life. Therefore, a circular bioeconomy needs to acknowledge the fundamental role of biodiversity, not only through appropriate conservation measures, but especially by promoting biodiverse ecosystems as the basis for productive and resilient landscapes and industries. At the same time, a circular bioeconomy is needed to replace the extractive fossil-economy, which is the main threat for biodiversity globally.

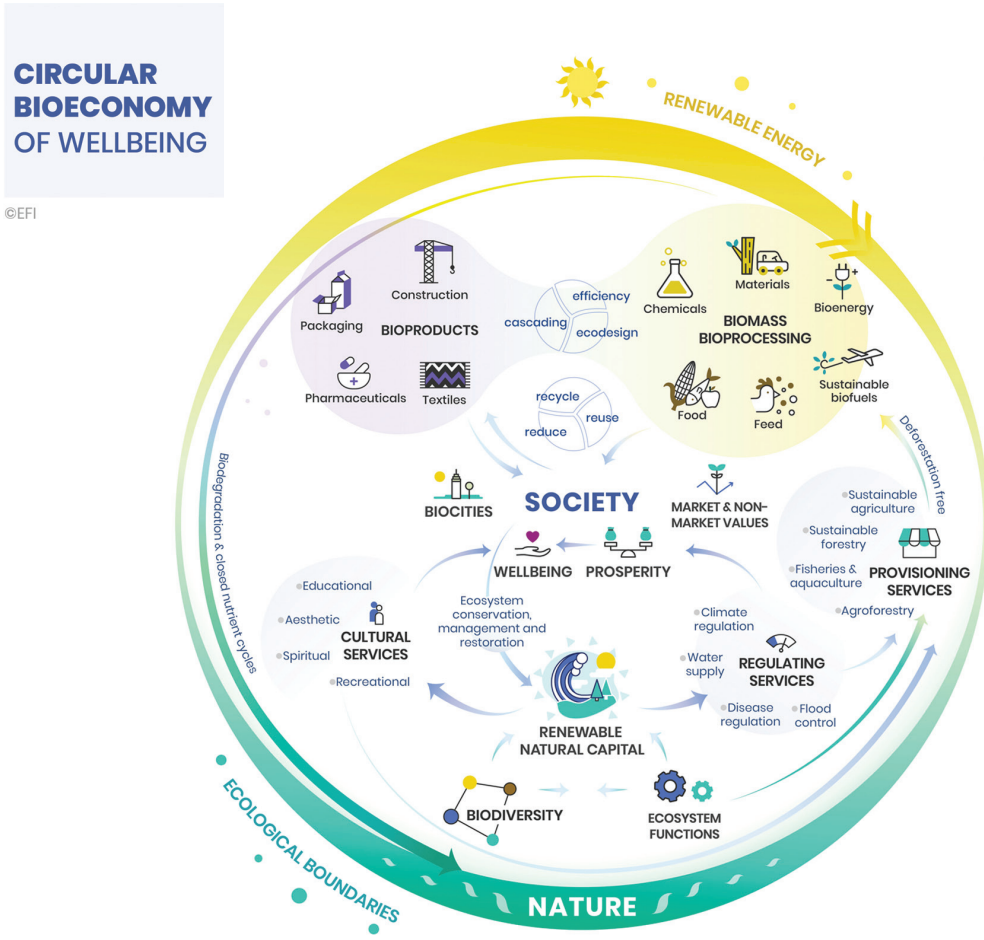

Figure 1.2 A circular bioeconomy © EFI

Forest resources are central to a circular bioeconomy

If we want a sustainable future anchored in a circular bioeconomy, our forests are key as they are the most important terrestrial biological infrastructure to sustain life on our planet, being:

- The main host for terrestrial biodiversity;
- The largest terrestrial carbon sink;
- The main terrestrial source of precipitation;
- The largest source for non-food and non-feed biological resources.

Therefore, our forests can be a crucial catalyst to transform the existing linear fossil economy into a circular bioeconomy. But unlocking its transformative potential requires a new and convincing vision regarding the future role of forests, forestry, and forest-based solutions.

We also need actionable strategies that bring the new vision to action. Above all, future forest strategies need to provide new lenses to see our forests not as "compensation" for the existing broken economic system but as a transformational force to create a circular bioeconomy paradigm.

In this context, a visionary and actionable Forest Strategy for Romania is also needed because in the next decade we will face an unprecedented situation characterized by two main structural impacts. On the one hand, climate change and natural disturbances could bring many of the forests in Romania to a tipping point where they can no longer provide the ecosystem services that we demand of them. On the other, forestry and the forest-based sector will face unique opportunities related to its potential to generate a new range of renewable, biobased solutions that are crucial to decarbonize our economy, while creating jobs for a socially and territorially fair green transition. The "market traction" generated by these emerging opportunities is indispensable for financing the integrated adaptation-restoration measures required to ensure the health and resilience of Romanian forests. These structural changes are not only limited to Romania but applicable at European and global level.

Biodiversity

Enhancing forest biodiversity is one of the most important investments that the forest sector in Romania can make to ensure its long-term economic resilience. The socio-ecological characteristics of Romanian forests require dynamic conservation and integrated management approaches to foster biodiversity at different (but coordinated) spatial scales: increasing tree species and genetic diversity to increase the resistance, resilience and adaptability of forests and restore rare and threatened forest ecosystem types; maintaining and restoring habitats of forest-dwelling species by promoting structurally diverse forests with sufficient amounts of deadwood and habitat trees; and coordinating landscape management and planning, including in rural and urban areas, at regional and even transnational level to create biodiversity corridors and to ensure the connectivity of high-value habitats such as old-growth forests (Pötzelsberger et al. 2021).

Innovation

Investing in innovation is crucial if the Romanian forest-based sector is to unlock its potential in the context of the EU Green Deal and to meet its climate and biodiversity targets. Moving towards a climate-neutral economy not only means replacing fossil energy with renewable energy, it also means moving to fossil-free materials, substituting carbon-intense products like plastics, concrete, steel, and synthetic textiles with lower carbon alternatives. For example, we can now transform wood, the most versatile biological material on earth, into a new revolutionary material called nanocellulose: five times stronger than steel but also five times lighter. The first car made of **nanocellulose** was unveiled last year in Japan. A new generation of sustainable and circular wood-based textiles with a three-to-five time lower carbon footprint than plastic fibers like polyester is now possible too. **Engineered wood products, such as Cross Laminated Timber (CLT)** are the most effective way to reduce the carbon footprint

of the construction sector, currently dominated by two carbon-intense and resource-intense materials: concrete and steel. These products help to mitigate climate change and also provide other positive environmental impacts. Thus, the future forest strategy for Romania would benefit from the development of an innovation plan to attract international investments in start-ups and scale-ups, access to finance and risk-taking capacity to stimulate new business models and value chains to decarbonize key industrial sectors using sustainable forest-based solutions. This shift is **an opportunity to modernize and make industries in Romania more circular.**

But innovation – particularly in the case of Romania which has some of the most unique natural heritage on the continent – should also address the need for new business models to market ecosystem services connected to the provision of biodiversity, non-wood forest products as well as recreation and eco-tourism connected to its natural and cultural capital.

An opportunity to tackle inequality

One of the most important societal challenges of this century is to address inequalities and to ensure **inclusive territorial prosperity**, including jobs and infrastructures in rural and "depressed" areas. The way forest and agriculture resources are owned, distributed, and managed offer great opportunities to tackle such challenges.

Forest resources in Europe are a good example of inclusiveness: they occupy more than 40% of the land and are owned by about 16 million forest owners. Wood-based value chains in Europe include around 400,000 companies, mostly small enterprises, and provide more than 4 million jobs (Mauser 2021). This is a very valuable socio-ecological infrastructure that needs to be acknowledged and nurtured as a basis for redistributing wealth, jobs and innovation. The Romanian situation is paradigmatic as it has the highest rural population share in the EU while coal mining is still an important economic activity. This means that Romania will need to develop employment opportunities in rural areas to replace jobs from the coal mining sector and to ensure a socially and territorially inclusive green transition. Forestry and the forest-based sector offer important alternatives while at the same time contributing to meet the country's climate and biodiversity targets. However, such employment transition requires investments in capacity building and training as well as raising awareness in rural areas.

Concluding remark

Policy frameworks, investments and forest management in Romania need to acknowledge that bioeconomy and biodiversity are two sides of the same coin; they need each other to create a new economy powered by nature that prospers in harmony with nature. The future forest strategy in Romania needs to take advantage of the new scientific and technological developments to develop and implement synergistic incentives and integrated approaches that connect mitigation and adaption efforts as well as bioeconomy and biodiversity goals.

Integrated approaches are key because the true challenge for the future is to increase simultaneously the ecological, economic, and social value of our forests.

Take-home messages:

- A circular bioeconomy offers a conceptual framework for using renewable natural capital to holistically rethink our land, food, and health systems as basis to transform industries and reimagine our cities to achieve sustainable wellbeing within ecological boundaries.
- The circular bioeconomy needs both advanced technology and innovation as well as traditional knowledge to succeed. But it ultimately relies on biodiversity as its true engine.
- Forests can be a crucial catalyst to transform the existing linear fossil economy into a circular bioeconomy.
- Policy frameworks, investments and forest management in Romania need to acknowledge that bioeconomy and biodiversity are two sides of the same coin.

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1.1 Romanian Forests and Forestry: An Overview

Valeriu-Norocel Nicolescu

Introduction

Romania is the largest country in the south-east of Europe and covers an area of 238,397 km^2, being the 12th largest country on our continent, and the 6th most populous member state of the European Union. Its terrain is distributed roughly equally between mountains, hills and plains. The Carpathian Mountains dominate the center of Romania, with fourteen mountain ranges reaching above 2,000 m.

Historically, Romanian forests have been a major source of rural employment through wood harvesting, wood processing, as well as non-timber forest products industries, playing an important role in the social and economic development of the country.

In this respect, this chapter aims to present the main characteristics of current Romanian forests and forestry, in the context of a necessary transition towards a predominantly circular, bio-based economy.

(i) Romanian forests: main characteristics

The current total area of forestland in Romania is 7.038 million ha (29.56 percent of national land), of which "lands covered by trees" are 6.93 million ha (http://roifn.ro/site/rezultate-ifn-2/). The original forest cover of Romania was estimated to be 70-80 percent of national territory (Florescu 1971, Giurescu 1976), the highest reduction of forestland occurring between 1829 (Peace of Adrianople) and 1922 (Land Reform following World War I), when ca. 3 million of forests were transformed into agricultural lands.

Romanian forests are located especially in the mountains (59.70 percent, forest cover 65.25 percent of the mountains), followed by hills (33.80 percent, forest cover 26.67 percent of the hills). Only 6.50 percent of the forests are found in the plains of the country (forest cover 5.25 percent of plains) (MAP 2018b, http://roifn.ro/site/rezultate-ifn-2/).

Romania is a country of broadleaved tree species, covering 74 percent of national forestland (MAP 2018b). Out of them, European beech *Fagus sylvatica* L. is dominant (31.51 percent), followed by oaks (sessile *Quercus petraea* (Matt.) Liebl., pedunculate *Q. robur* L., Hungarian *Q. frainetto* Ten, Turkey *Q. cerris* L., greyish *Q. pedunculiflora* Koch, and pubescent *Q. pubescens* Willd.- 16.72 percent), various hard broadleaves (i.e. hornbeam *Carpinus betulus* L., black locust *Robinia pseudoacacia* L., ash *Fraxinus* spp., maples *Acer* spp. - 19.06 percent), and various soft broadleaves (poplars *Populus* spp., willows *Salix* spp., linden *Tilia* spp. - 6.22 percent). Conifer species cover 26 percent of national forestland, being dominated by Norway spruce (*Picea abies* (L.) Karst.) (19.95 percent), followed by Silver fir (*Abies alba* Mill.) (4.36 percent), European larch (*Larix decidua* Mill.) and pines (*Pinus* spp.) (2.18 percent) (MAP 2018b).

During Communism (June 1948 - December 1989), all Romanian forests were state-owned; nowadays the country's forests are mostly public, and cover 4.277 million ha (65.9 percent of national forestland) (MAP 2018b). The State has the largest share of public-owned forests (48.6 percent, 3.14 million ha) followed by cities, towns, communes (1.137 million ha, 17.3 percent,

over 1,500 owners). Privately-owned forests cover 2.239 million ha (34.1 percent) and belong to over 4,000 associations, over 750,000 private individuals and over 4,100 legal entities. The mean size of forest holdings is highly variable, from 1.1 ha in the case of private individuals (of which 99 percent are smaller than 30 ha), 66.8 ha (legal entities), 265 ha (associations), up to 735 ha for cities, towns, communes (MAP 2018b).

Since 1954, Romanian forests that accomplish different functions have been divided into two Groups: I *Forests with special protection functions* with six sub-groups (1.1 to 1.5; sub-group 1.6 was defined only in 2018), and II *Forests with production and protection functions*.

The area of forests in Group I has increased from 12.7 percent of national forestland in 1954 to 66 percent at present. The current functional zoning of Romanian forests is depicted in Table 1.1.

Table 1.1 Current functional zoning of Romanian forests (MMAP 2021)

Group	Sub-group	%
I. Forests with *special protection functions*	1.1 Forests for water protection (predominantly *hydrological functions*)	66
	1.2 Forests for land and soil protection (predominantly *pedological functions*)	
	1.3 Forests with protection functions against natural or human-induced climatic factors (predominantly *climatic functions*)	
	1.4 Forests with protection functions predominantly *social*	
	1.5 Forests of *scientific interest*, for the preservation of forest gene-pool and eco-pool and of other high-value natural ecosystems	
	1.6 Forests with *special functions for biodiversity conservation and protection*	
II. Forests with *production and protection functions*	-	34

Forests in sub-groups 1.1 and 1.2 represent ca. 75 percent of Group I while forests in sub-groups 1.5 and 1.6 cover about 10 percent of the same group.

For Group I, sub-group 1.5., the most relevant components are forests part of the Natura 2000 sites (both Sites of Community Importance SCI - cover 16.80 percent of national land -, and Special Protection Areas SPA - 14.89 percent of national land), as well as primary virgin forests (8,579.8 ha) and secondary virgin forests (61,489.2 ha as of December 15, 2021) (http://www.mmediu.ro/articol/catalogul-padurilor-virgine-si-cvasivirgine-din-romania/4790).

The most important components of Group I, sub-group 1.6. are national parks, natural parks, scientific reserves, reserves and nature monuments, as well as Biosphere reserves - MAB/UNESCO Committee.

In addition to the two Groups and six Sub-groups, 87 so-called "functional categories" (FC) have been defined and used at sub-compartment level, of which 83 for Group I (the majority in sub-groups 1.5. - 21 FC - and 1.6. - 18 FC) and only 4 for Group II (MAP 2018a). This makes the Romanian system of forest zoning probably the most complicated in Europe; nevertheless it is heavily focused on protection functions rather than on timber production.

At sub-compartment level, depending on these functional categories, six functional types (TI -TIV for forests belonging to Group I and TV-TVI for those in Group II) describing the type and intensity of silvicultural interventions have been created. The level of management ranges from no silvicultural intervention allowed (TI) to all kinds of silvicultural systems allowed (TVI) (Table 1.2).

Table 1.2 Distribution of Romanian forests by functional types (MAP 2018a)

Functional type	Share of forests (% of area)
TI: no silvicultural interventions allowed	3
TII: no silvicultural systems allowed; only conservation cuttings* allowed	21
TIII: only intensive silvicultural systems - group selection, irregular, group, uniform shelterwood - based on natural regeneration are allowed. Small-scale (maximum 3 ha) clear-cutting allowed only in the case of even-aged Norway spruce, pine, poplar, willow, or black locust stands	8
TIV: only intensive silvicultural systems (group selection, irregular, group, uniform shelterwood), based on natural regeneration are allowed. Small-scale (maximum 3 ha) clear-cutting allowed only in the case of even-aged Norway spruce, pine, poplar, willow, or black locust stands	21
TV: all silvicultural systems are allowed, depending on species composition, stand structure (regular vs. irregular) and functional type	5
TVI: all silvicultural systems are allowed, depending on species composition, stand structure (regular vs. irregular) and functional type	42

** Conservation cutting: intervention applied in stands fulfilling special protection functions that aims to allow for the establishment of a new cohort using low intensity cuttings, from the one specific to sanitary cutting to maximum 10-15 percent of standing volume per decade.*

The most relevant forests included into the TI classification are primary and secondary virgin forests, zones strictly or integrally protected as national parks and natural parks, as well as zones strictly protected as Biosphere reserves and UNESCO sites.

Natura 2000 sites (both SCI and SPA), as well as zones of sustainable development of protected areas (e.g. national parks, natural parks, etc.) are part of TIV.

According to the last national forest inventory (http://roifn.ro/site/rezultate-ifn-2/), the total standing volume of Romanian forests is 2,355 million m^3, so the mean volume per ha reaches 340 m^3 (from 250 m^3 in soft broadleaves, 279 m^3 in oaks, 416 m^3 in European beech, to 424 m^3 in conifers).

The current annual increment of Romanian forests (8.46 $m^3\ ha^{-1}\ yr^{-1}$) is one of the highest

in Europe and ranges between 7.24 m3 ha^{-1} yr^{-1} in oaks, 8.98 m^3 ha^{-1} yr^{-1} in European beech, and 10.86 m^3 ha^{-1} yr^{-1} in conifers. Consequently, the current total annual increment at country level reaches 58.62 million m^3, of which 67 per cent in broadleaves and 33 per cent in conifers (roifn.ro/site/rezultate-ifn-2/).

Although the current total annual increment is very high, the annual allowable cut of Romanian forests is considered to be only of maximum 23 million m^3; this low level has two main reasons: (i) the unbalanced age-class distribution, dominated by stands between 21 and 80 years old (Figure 1.3), and (ii) the low accessibility of forest land.

Figure 1.3 Current age-class distribution of Romanian forests (www.mmediu.ro/app/webroot/uploads/files/2016-06-08_Rezultate_IFN.pdf)

In terms of age-class distribution, 71 percent of Romanian forests are maximum 80 years of age, with the peak in age class III (41-60 years), and only 15 percent are older than 100 years. However, not all forests in the latter category are primary or secondary virgin forests where no silvicultural interventions are allowed; most of these are managed using different silvicultural systems that are typical to high forests with long rotation ages (over 100-120 years).

The low accessibility of Romanian forests is another major problem when considering the annual allowable cut. It is only 65 per cent, for a mean skidding distance of 1.2 km and a maximum one of 2 km. In this respect, the current density of forest road network in Romania is only 6.5 m ha^{-1}, much lower than in countries like France, Austria, Switzerland, Germany, where it ranges between 26 m ha^{-1} (France) and 45 m ha^{-1} (Germany). It is much lower than the one considered as optimum in Romania of 12-20 m ha-^{1} (Giurgiu 1982).

Under these unfavorable circumstances, the annual wood removal in Romanian forests after the fall of Communism (1989) has been below the annual allowable cut and ranged between 13 and 19 million m^3, with an average of ca. 15 million m^3 (see Figure 1.2. for the 2007-2017 period).

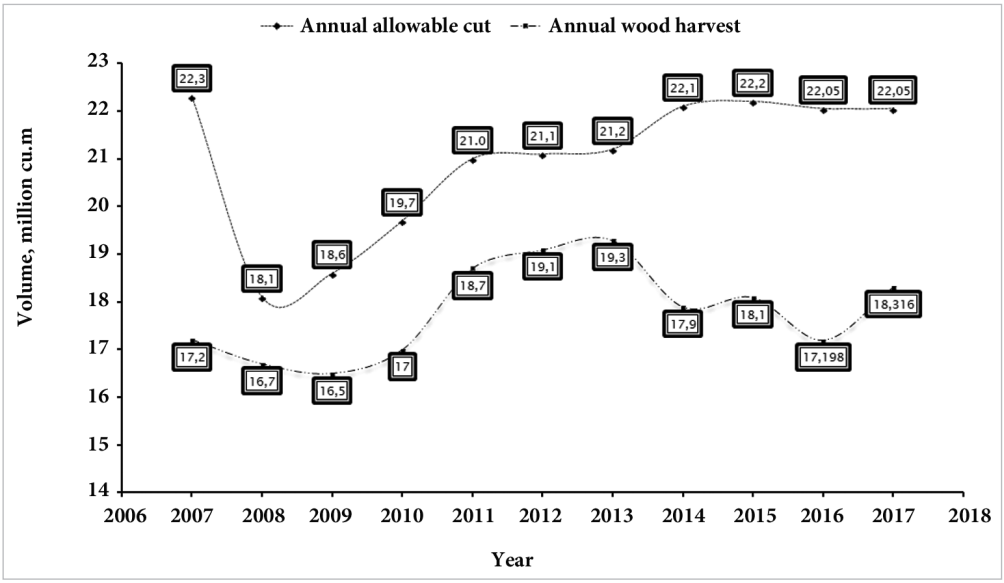

Figure 1.4 Annual allowable cut and annual wood removal in Romania between 2007 and 2017 (sources: *Starea pădurilor României* (annual allowable cut) and *Anuarul statistic al României* (annual wood removal)

These figures are much lower than the annual wood removal during the Communist period; for instance, between 1954 and 1989, the amount of wood removed annually ranged between 20 and 27 million m^3, with an average of 25 million m^3.

(ii) Management of Romanian forests

All Romanian forests are managed following forest management plans (FMPs), which are usually revised every 10 years. The revision cycle is 5 years only in case of forests consisting of poplars, willows or other fast-growing tree species. The FMPs are produced solely by authorized and specialized forest management planning companies; they are compulsory for forest holdings larger than 10 ha (Codul silvic 2008).

All management activities are based on the current legal framework which includes the Forest Law (Codul silvic, released in 2008, but revised many times since then), specific Technical Norms (no. 1...7/2000), Ministerial Orders, etc.

According to these documents, all Romanian forests, regardless of the ownership state, must be either (i) managed, based on FMPs, or (ii) must provide various ecosystem services. These activities have to be performed only by forest districts authorized by the state authority in charge of Forestry issues, and are either (1) state (part of National Forest Administration – ROMSILVA) or (2)"regime" (i.e. forests belonging to cities, towns, communes, to individual owners or legal entities owning forest land or to associations established by them).

In terms of *Regeneration methods/systems* applied in Romanian forests, they are imposed by the Forest Law (Codul silvic 2008) through FMPs and consist of high forest, which should be applied to most forests (over 90 percent currently, compared to 70 percent in 1948), as

well as coppice (only for native poplars, willows, black locust stands; currently it is used on 5% of national forestland, compared to 30% in 1948). The coppice-with-standards system was forbidden in 1948 and it has never been applied since.

The *regeneration cuttings/silvicultural systems* are also imposed by the specific Technical Norms (MAPPM 2000c) through FMPs, depending on tree species, stand structure (regular vs. irregular), productivity level (high, average and low) and functional type (TI-TVI). The dominant silvicultural systems are those specific to high forests: group and uniform shelterwood cuttings, applied on over 60 percent of annual logging area, single-tree and group selection cuttings (ca. 5-7 percent of annual logging area), and clear-felling ca. 4-5 percent of annual logging area and used only in even-aged stands of Norway spruce, pines, hybrid poplars, and willows. The maximum size of clear-felled areas is 3 ha and can be up to 5 ha only in hybrid poplar and willow stands, when site preparation is carried out mechanically.

Marginally, coppice systems (both low and high) are also applied to ca. 4-5 percent of annual cutting area.

In terms of *artificial regeneration* of Romanian forests, all specific issues (e.g. species composition, planting schemes, stocking/density, etc.) are imposed through the FMPs, based on the current Technical Norms (MAPPM 2000a). Certain provisions (e.g. almost exclusive use of native tree species; high planting densities - 4000-5000 plants ha^{-1} for Norway spruce, 5000 plants ha^{-1} for Silver fir, 2000-2500 plants ha^{-1} for European larch, 5000 plants ha^{-1} for European beech, 5000-6700 plants ha^{-1} for oaks) are compulsory regardless of the ownership type.

The type, intensity, and cycle of *tending operations* (i.e., release cuttings, cleaning-respacing and thinning) is imposed by the specific Technical Norms (MAPPM, 2000b) through FMPs and are compulsory. The intensity of thinning, regardless of the dominant tree species, is low-moderate (maximum 18% of standing volume) and decreases with age (Table 1.3).

Table 1.3 Recommended intensity of thinning (% of initial standing volume), in stands with a canopy cover of 90-100% (from MAPPM 2000b)

Forest formations or groups of forest formations	**Stand age, years**									
	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90	91-100	Over 100
Norway spruce		16	11	10	9	8	7	6	6	5
Silver fir		16	12	10	9	8	7	7	6	5
Mixed European beech-conifers		15	12	10	9	8	7	7	6	5
European beech		15	14	13	12	10	9	8	7	5
Mixed European beech-sessile oak		15	13	10	9	8	7	6	5	4
Sessile oak and pedunculate oak		14	12	10	8	7	6	5	4	4
Mixed oak-dominated stands in the plain and floodplain areas		14	12	10	8	7	6	5	4	4

Forest formations or groups of forest formations	Stand age, years									
	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90	91-100	Over 100
Linden	18	12	12	10	7	6				
Black locust	15	10								
Alder	15	12	10							
Willows	16	12								
White poplar, black poplar and their mixtures	16	7								
Pines	18	15	12	10						
Douglas-fir		16	12							

The last thinning can be carried out when the stand reaches 3/4 of rotation age (generally maximum 80 years); afterwards, until the rotation age, only application of salvage (sanitary) cuttings is allowed.

In terms of *rotation ages*, imposed by specific Technical Norms (MAPPM 2000d) and applied through FMPs, they depend on the tree species, target wood assortment and yield class (longest at production class I and shortest at production class V). In stands fulfilling *production and protection functions* (Group II), the rotation ages can reach values of up to 140 years (target wood assortment: sawn timber) or of up to 200 years (target wood assortment: veneer wood) (Table 1.4 and Figure 1.3).

Table 1.4. Rotation ages for the most important tree species in stands fulfilling production and protection functions (from MAPPM 2000d)

Species	Target wood assortment	Rotation age, years
Norway spruce	Sawn timber	100-120
	Resonance wood	150-180
Silver fir	Sawn timber	100-120
	Resonance wood	150-180
European beech	Sawn timber	100-120
	Veneer wood	140-150
Sessile oak	Sawn timber	120-140
	Veneer wood	160-200
Pedunculate oak	Sawn timber	110-130
	Veneer wood	160-180
Black locust	Sawn timber, construction timber	25-35

Figure 1.5 Pedunculate oak-dominated stand at rotation age, before and after logging

In stands fulfilling special protection functions (Group I), the rotation ages are 10-20 years longer than in the case of those mentioned above for stands belonging to Group II.

In conclusion, all management measures carried out in Romanian forests are part of FMPs and mandatory to all forests, regardless of the ownership type. Unfortunately, Romanian forest owners (public or private) do not play any role in choosing forest management measures, such as regeneration methods, tending operations, silvicultural systems, rotation ages, etc. As emphasized by Nichiforel et al. (2018), Romania is one of the most restrictive countries in Europe in terms of ownership/property rights, leading to a blockage of wood resources, especially in small-size forest holdings.

Wood harvesting in Romanian forests is carried out by about 4,800 private logging companies, the majority with an annual logging potential below 10,000 m^3. The wood harvesting sector is characterized by (1) low investment in new machinery and technology, and (2) low productivity which makes the costs of logging per m^3 higher than the European average cost. In addition, the wood harvesting field, as well as the silvicultural interventions field, are facing two major problems: (i) chronic shortage of labor (especially qualified personnel, mostly for logging activities, but also for forest nurseries or tending operations – beating-up, weeding, release cutting, cleaning-respacing, tree marking for thinning – in young stands), and (ii) the continuous growing costs of labor.

Finally, despite all the above-mentioned challenges, it is worth mentioning that the contribution of Romanian Forestry (Silviculture and Wood Harvesting) field to the national GDP is ca. 2 percent.

Summary

Romanian forests, mostly publicly-owned and dominated by European beech and Norway spruce, are located predominantly in the Carpathian Mountains and have a high production and productivity.

Historically, Romania has performed a *close-to-nature* forestry, based on establishment and management of mixed stands, predominantly with native tree species, through natural regeneration of forests using silvicultural systems specific to high forest system, long rotation ages, and a small-scale use of clear-cuttings.

Take-home messages:

- Romania is a `country of broadleaves`, with European beech the dominant tree species.
- Current management of Romanian forests approaches the close-to-nature forestry model.
- The level of annual wood removal in Romanian forests is much lower than both the annual allowable cut and total current annual growth. As this situation is mostly due to the unbalanced age-class structure and low accessibility of forest land, which are supposed to improve in the future, the level of annual wood removal is expected to increase, providing enough industrial and firewood for domestic consumption.

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1.2 Biodiversity Conservation in Forest Management

Petru Tudor Stancioiu

Introduction

Ever since the Convention on Biological Diversity (CBD) entered into force in December 1993, the conservation of biological diversity has been high on the international policy agenda. In light of the challenges posed by climate change, this concept has been proposed as one of the most viable approaches for a successful human coexistence with nature. As mentioned at the beginning of the book, our forests are some of the most biodiverse ecosystems but also one of the most important sources of natural resources and other various ecosystem services. Today, conserving biological diversity in forests has become a cornerstone for sustainable management across the globe. Moreover, the concept of circular bioeconomy, introduced through the EU Bioeconomy Strategy and recently strengthened by the EU Green Deal, must take into account the needs for biodiversity conservation, since biodiverse ecosystems provide the basis for "productive and resilient landscapes and industries" (see Impulse 1). This can be achieved through wise and integrated forest management that values the forest ecosystem's multi-functionality, strengthens its role as a carbon sink whilst enhancing its resilience to climate change, and supports the socio-economic development of rural areas (EU Forest Strategy 2021). Hence, adapting our approach to forest resource management in order to meet these ever-changing demands is crucial. Although the principles of sustainable forest management are defined by international treaties (e.g. MCPFE 1993), differences in practices that implement this concept still occur in different parts of the globe and even among neighboring countries of the same region. For example, Member States, despite being bound by common rules of the European Union, differ widely in terms of both biodiversity conservation and forest management.

Romania provides an interesting case for analysis. Under continuous regulated management (applied during the last century and longer in some parts of the country), Romanian forests harbor some of the largest areas of primary forests (Ioras et al. 2009) and the largest carnivore populations in the EU (Chapron et al. 2014). The well-connected forested landscapes (Stăncioiu et al. 2018) offer good habitat conditions for vigorous populations of diverse species of plants and animals which are threatened in other parts of Europe. Although forest management rules remained mostly unchanged, at present, mass media often depicts the situation of forests and forestry at national level as catastrophic. Justifiable management practices are equated with illegal logging that destroys old growth forests. Far too often, cases of illegal logging are generalized, misinterpreted and taken out of context, depicting the entire forest sector as unprofessional. As a result, any timber transports are mislabeled as signs of the vanishing forest. Both the forest-based sector and the mass media need to find ways to better communicate reliable information about forests and forestry to the broader public. The first step in this direction is to provide a more comprehensive and fact-based perspective on the important role of forest management for biodiversity conservation in Romania's forests. However, before describing and discussing the particular case of Romania, a general understanding of forest biodiversity and its continuous change in time is important.

Understanding forest biodiversity

Forest-dwelling species and their needs

The existence of any living organism depends on the environmental conditions available at a given moment in time, and in a certain place. This is called "*habitat*" or the "*the growing space*" defined for trees as being "*all resources needed by a tree to exist on a given site*" (O'Hara 1988). However, it is wellknown that species' needs differ greatly. For example, some trees (but also other plants) are light-demanding while others are shade-tolerant, some are sensitive to soil fertility and/or moisture while others are more tolerant to a scarcity of these. Animals also have different adaptations to different environments. Therefore, while some species could be found together (as they look for similar environments) other species, with very different habitat needs, will be found somewhere else. It is also well known that habitat conditions are directly influenced by the type of forest (species composition, its vertical and horizontal structure, age – development stage etc.). As a result, we should not expect that all species thrive in the same place (i.e. a certain type of forest or habitat) but rather in many different places (i.e. different types of forest offering various habitats).

The large-scale approach for the conservation of forest biodiversity

Simply said, for maintaining a high (or the highest possible) number of species, good habitat conditions for all species sought for conservation should continuously be provided. But, taking into account the above-mentioned conditions, this simple and straightforward prerequisite requires very large forested areas (to accommodate for large and viable populations) with different structures (to accommodate the different needs of different species). However, large enough tracts of land without human impact are not available anymore, especially in places where humans have been present for millennia (which is the case of "the old continent" Europe). Therefore, conservation efforts must include lands with human presence, under different levels of resource management and together with other constraints. Nowadays, this has become a common approach. The Natura 2000 conservation concept of the European Union is a good example of this, having the overall aim to ensure the long-term survival of species and habitats (considered of community interest), while taking into account the economic, social, and cultural requirements as well as the regional and local characteristics[6]. As a result, the conservation of biodiversity and the management of natural resources are brought together under the concept of sustainable use of natural resources.

This large-scale approach is a must because it offers sufficient area for vigorous populations and also provides room for various structures (different habitats). This is the key to addressing another reality that makes conservation challenging: the fact that forests are dynamic with or without human interventions. Although this dynamic is natural, it is quite often overlooked and misunderstood.

[6]https://ec.europa.eu/environment/nature/legislation/habitatsdirective/index_en.htm

Understanding forest dynamics

Forests, like all other ecosystems on Earth, change in time with or without human intervention. All living parts of the forest have a similar fate to that of any living creature on Earth (including humans): they are born, grow up and die. In addition, the short or long-term fluctuations of the nonliving environment and the various interactions among different species (autogenic change) directly influence the evolution of the living community. Moreover, natural disturbances (allogenic change) are continuously shaping the forests. In general, the natural change across the lifespan of a stand can be shortly described by four different development stages (Oliver and Larson 1996, Figure 1.6):

1. **stand initiation** = after a stand replacing disturbance, the released (and now available) growing space is invaded by many species, different in terms of their shade tolerance and size/type (competition is not yet limiting the presence of less tolerant species and high biodiversity occurs);
2. **stem exclusion** = the young stand has a closed canopy and intense competition is the norm. As a result, most herbaceous plants and shrubs are eliminated by the more competitive trees and diversity is severely decreased;
3. **understory re-initiation** = in the mature stand, gaps produced by dead trees cannot be closed by neighboring trees and therefore, as some growing space becomes available (i.e. more light reaches the ground), other plants and a new generation of trees establish on the forest floor;
4. **old-growth** = the trees installed from the beginning (under the stand initiation phase) reach their senescence (i.e. the maximum physiological age) and die in an irregular fashion. Large gaps (i.e. more growing space becomes available) provide conditions for growth to already installed regeneration but also to new tree cohorts and other plants (diversity increases again).

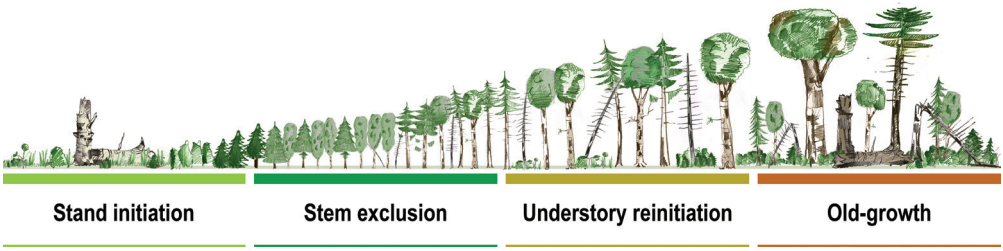

Figure 1.6 The four stages of stand development according to Oliver and Larson (1996).(figure adapted after Vlad et al. 2020)

While this relatively simple description of a stand development helps our understanding of forests as dynamic ecosystems, it should be noted that disturbances which are driving the change vary greatly in time and space, and also in terms of their type, intensity and frequency. Therefore, autogenic and allogenic factors and/or processes are continuously shaping the forest ecosystems in very different ways, and no single pattern can be used to explain change (i.e. nature cannot be completely framed in our models and books). This complexity of change makes it very difficult to thoroughly understand and especially to precisely predict the future of our forests. However, we must accept the fact that change also occurs naturally and is inevitable. It is not solely the result of "unnatural" human activity.

The outcome of natural dynamics

We should become accustomed to the fact that, whether we like it or not, forests are continuously changing over time. The young forest will become mature and old as time passes, while the old forest will be replaced by a young regeneration one day. Natural disturbances (wind, insects, fire, floods etc.) can speed up this process and produce very different outcomes (e.g. replacing stands with uniform vertical or horizontal structures with more diverse ones and vice versa; replacing stands with uniform species composition with more diverse ones and vice versa). Combined with or influenced by human activities such as forest management, the diversity of patterns which could emerge is very high. However, the very simple and direct outcome of the natural (but also anthropogenic) change in forest ecosystems is that habitat conditions for species are changing over time in the same place. As a result, in that place, the habitat for certain species can either become more favorable or unfavorable over time. This drives a **continuous change in species composition and abundance** in each place (i.e. the well-known ecological succession), **a normal evolutionary process of the forest ecosystems**.

Moreover, we must be aware that classifying a change as good or bad is the result of our subjective judgement. Change in habitat conditions is making some species leave, and others to establish. Thus, while change is bad news for some species, it is good news for others (i.e. any disturbance that degrades growing space of some species creates growing space for others). One more important step in accepting this is to understand that species judge habitat by the resources it offers (i.e., the growing space) and not based on aesthetics.

But, if change is inevitable, what role does the human-driven change play?

The change driven by forest management

Forest management can play an important role in supporting nature conservation while at the same time providing valuable forest products and other ecosystem services. Despite the centuries-old sustainable management of our forests, some relatively recent ill-considered management decisions (for example, intensive or exotic species plantations falling prey to insect outbreaks favored by unusual climatic events, or practicing clearcutting on large areas) and poor law enforcement (which has allowed for too intensive /illegal harvesting in some places) have seriously eroded the public trust in forest stewardship. As a result, forest management is often considered by citizens as incompatible with biodiversity conservation and/or climate mitigation efforts.

However, the long tradition in forest management around the world has arguably contributed to ensuring the continuity and even richness of flora and fauna species in some areas. This suggests that satisfying human needs must not always come at the detriment of biodiversity conservation. Indeed, field evidence and scientific textbooks show that human interventions can reach similar effects with natural disturbances (Figure 1.7). Therefore, they can successfully produce and maintain various structures which offer diverse habitats for different species (Table 1.5).

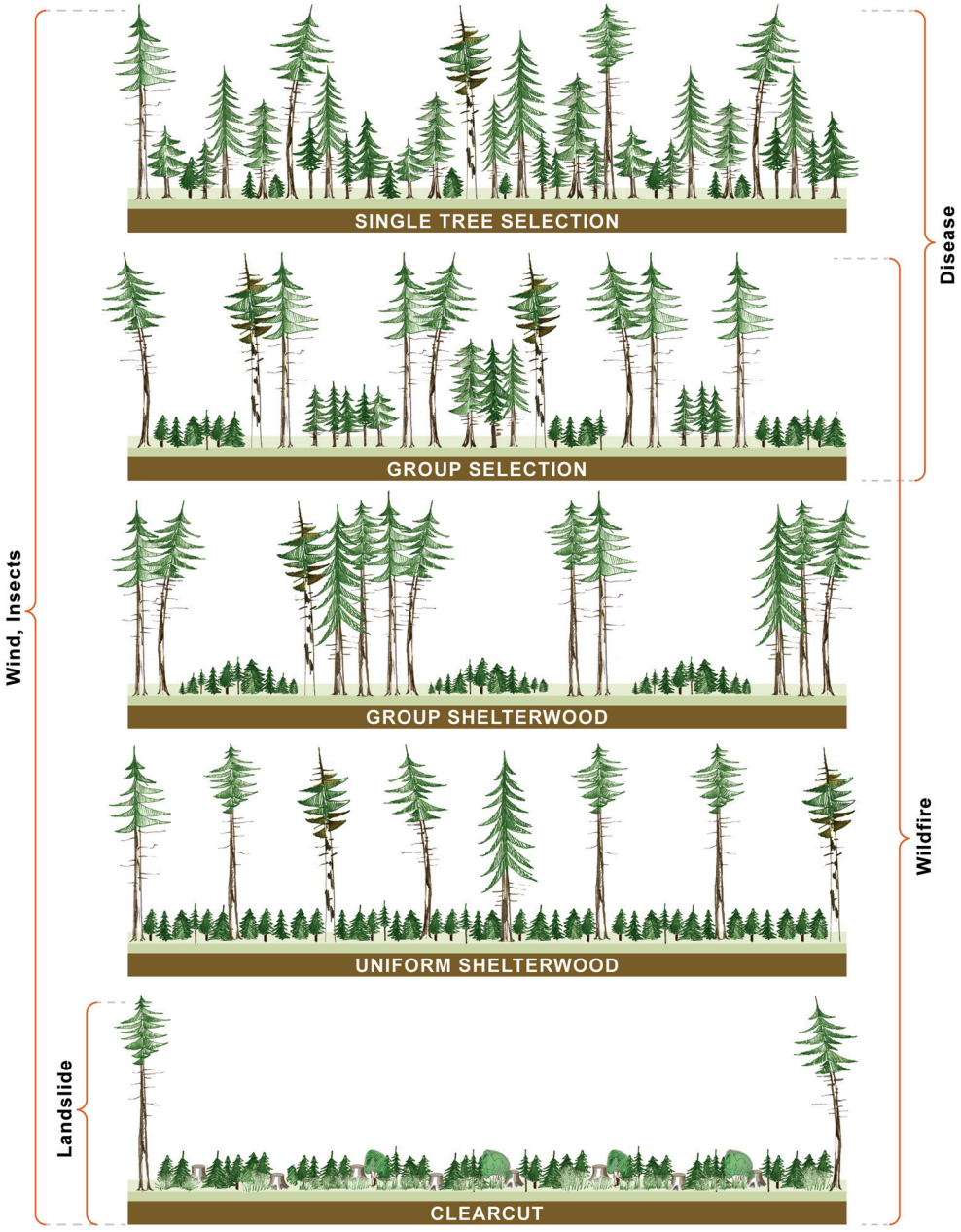

Figure 1.7 Effects of different silvicultural interventions on stand structure and similarity to natural disturbances[7] (Note: the intensity of disturbance increases from the top to the bottom; the same type of disturbance could produce very different outcomes, depending on its intensity and spatial model)

[7]Information on natural disturbances emulated by various silvicultural systems adapted from Kimmins (2004)

Table 1.5 Outcomes of different regeneration cuttings (i.e., silvicultural interventions to replace the old forest with a new regeneration) depicted in Figure 1.7.

Intervention	Outcome
Clearcut	All trees from the main canopy are removed in one step providing conditions for regeneration in full sunlight. All growing space becomes available for new plants (including tree seedlings, naturally seeded or planted). Until the established young tree regeneration closes the canopy again, very different species (type, size, shade tolerance) coexist, as competition is not too intense and has not yet eliminated less tolerant species. The future stand will have a uniform structure (even aged).
Uniform Shelterwood	Trees from the main canopy are partially removed by uniform thinning of the canopy to create conditions for regeneration in partial shade (the cutting releases enough growing space that cannot be entirely occupied by residual big trees). After a few years, in order to ensure growth of installed seedlings and further establish new seedlings, remaining trees of the main canopy are removed (**uniformly in the stand**) in two subsequent steps. During the regeneration cuttings, the stand will be two-aged (as depicted in the figure). After the regeneration process is complete, only the young cohort remains and the stand will have a relatively uniform structure (even aged or close to even aged).
Group Shelterwood	Trees from the main canopy are partially removed (in groups) to promote regeneration in gaps with partial side protection from the old stand (the cutting releases enough growing space that cannot be entirely occupied by residual big trees). After a few years, to stimulate growth of already installed seedlings, and support the installation of new seedlings, the remnant trees of the main canopy are removed (**by enlarging the initial gaps**) in two subsequent steps. As in the case of uniform shelterwood, during the regeneration cuttings, the stand will be two-aged. Afterwards, it will have a relatively uniform structure (even aged or close to even aged).
Group Selection[8]	Trees from the main canopy are repeatedly removed in small groups (smaller openings than for group shelterwood) to promote regeneration in small gaps of partial shade (more shaded environment - less growing space released - than for group shelterwood; shade tolerant species are favored). Further interventions will open similar gaps in other parts of the stand and favor the establishment of other generations of trees. In time, the stand will harbor different patches with trees of various ages and sizes. Therefore, it will have a relatively diverse structure (multi aged / uneven-aged).
Single-tree selection	Similar to Group Selection, but here individual trees or very small groups of trees from the main canopy are being removed repeatedly, releasing small amounts of growing space. Regeneration is being established in very small gaps (shade tolerant species are favored). In time, the stand will contain trees of various ages and sizes, with a relatively uniform spatial distribution, not clumped as under group selection. The stand has an irregular structure (uneven-aged).

The "close-to-nature" paradigm

A management taking into account all species' needs is defined as being *close-to-nature* and it is often promoted as an alternative to other practices i.e., use of exotic species to replace native species, intensive short rotation plantations, simplified stand compositions, or large clear-cuts. Moreover, the European resolution setting the General Guidelines for the Sustainable Management of Forests in Europe (MCPFE 1993) states that "*silvicultural practices emulating*

[8]The Conservation cuttings (see section 1.1. of the book) produce similar outcomes to the Group selection and Single-tree selection

nature should be encouraged". However, this concept is often misinterpreted and biased towards aesthetically pleasing and picturesque structures. If we accept that natural disturbances create certain habitats and therefore favor certain species, we should also accept that a *close-to-nature* management must emulate all natural disturbances (to please all species). Instead, there is an increasing pressure to restrict the use of certain silvicultural practices (underlined by Bucur in the Expert Insights section at the end of this part) even though they mimic natural disturbances and create optimal habitats for many species. The most common case is that of clearcutting which is much less harmful to ecosystems than some natural disturbances (like landslides or stand-replacing fires). Carried out on small areas (1-3 ha), clearcutting can even be less harmful than large-scale windthrows. However, because it is aesthetically displeasing (Kimmins 1999), people overlook the importance of small clear-cuts for biodiversity, especially in a large-scale compact, densely forested landscapes where they create unique conditions for many plants (especially light-demanding, small size species) and animals (insects, herbivores, etc.). As a result, clearcutting as a method (even in small areas) is nowadays considered incompatible with the *close-to-nature* paradigm.

On the other hand, the unevenaged management approach (single-tree and group selection) is often deemed as the only silvicultural intervention which is *close-to-nature* and therefore provides the best preconditions for achieving the highest biodiversity. This idea continues to be on the biodiversity policy agenda, despite experience from European countries with a long silvicultural tradition (Schutz 1999, Schall et al. 2018, Schall et al. 2020) showing different results. This bias is probably caused by aesthetic preferences for structure (Kimmins 2001) which masks obvious signs of disturbance by maintaining a continuous cover. However, this approach too has some important shortcomings in terms of:

- biodiversity: it produces only one type of structure (= one type of habitat) and does not emulate other different types and intensities of common disturbances. The resulting structures do not cover all habitat needs for all species. They mostly favor shade-tolerant species while naturally occurring light-demanding species are less represented or even absent. They also create much more forest edges, thus favoring "edge species"[9] and disfavoring "interior species"[10];
- environmental impact: more frequent interventions spread across larger areas result in higher (temporal and spatial) disturbance to flora and fauna; it also produces higher damage to residual trees during harvesting;
- economic revenue: higher management and harvesting costs (it requires a denser road network) and timber often has lower quality.

Close-to-nature silviculture must be understood more widely than is often the case today. As argued above, this system must include all the methods of regeneration that exist in natural forests. This means including both individual tree selection as well as more extensive forest regeneration forms performed in larger clusters (clear-cuts) in order to create corresponding conditions for different species. And, such diverse management approaches must be prioritized above aesthetics.

[9]These species thrive in ecotone conditions (with abrupt changes in environmental conditions), at the border (edge) of compact forest patches.

[10]These species require habitat conditions offered by the interior of large compact forest patches, away from edges.

Biodiversity conservation in dynamic forests

As mentioned earlier, change is inevitable and drives species relocation (i.e. spatial biodiversity dynamics). Therefore, maintaining an overall high biodiversity becomes a challenging task. Besides the large-scale condition which offers the chance to have different types of habitats across the landscape, the disturbance regime (natural or anthropogenic) must produce and maintain these various structures. Such a dynamic landscape continuously offering habitat conditions but in different places over time is called the **"shifting steady-state mosaic"** (Kimmins 2004) (Figure 1.8).

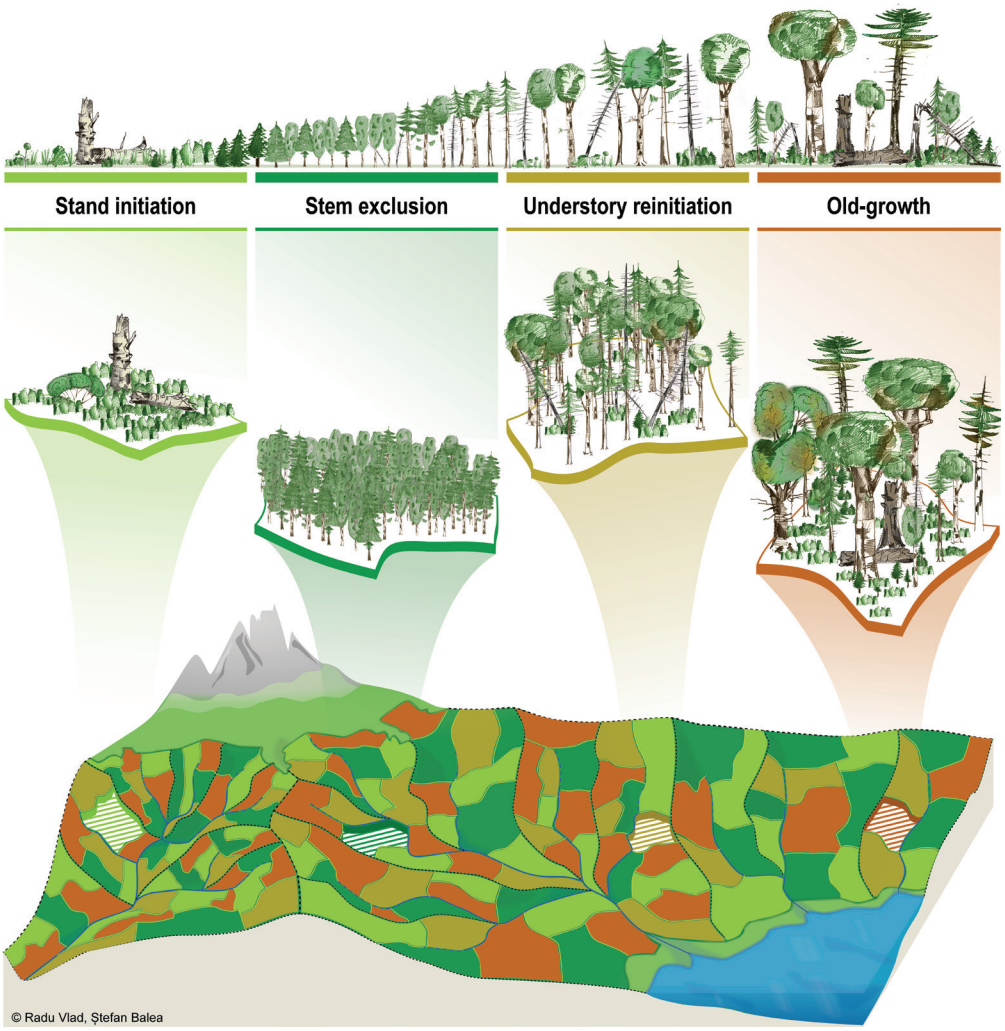

Figure 1.8 The "shifting steady-state mosaic" where all stages of development are continuously present, in different places over time, but in the same landscape (from Vlad et al. 2020)

The advantage of such landscape is that all different habitat conditions are present continuously, although in different places over time. This offers a **space-for-time substitution** to wild plants and animals and permanently accommodates both *specialized*[11] and *generalist*[12] species (Figure 1.9).

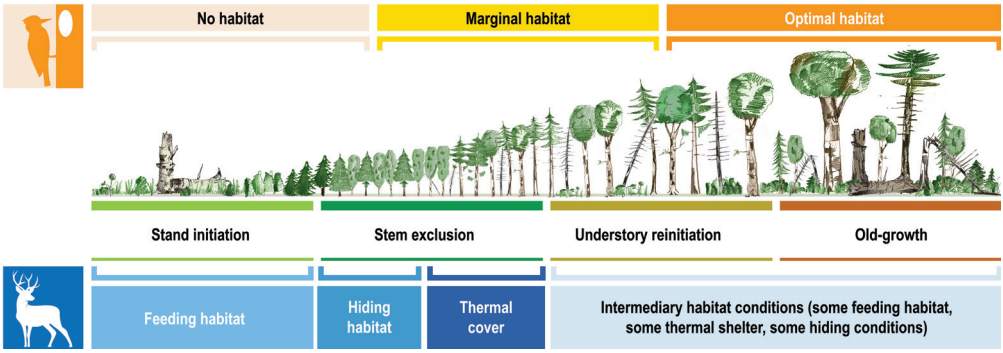

Figure 1.9 The four stages of stand development and the conditions offered to a specialized species (the woodpecker) and a generalist one (the red deer) (from Vlad et al. 2020, adapted after Smith et al. 1997).

However, in order to acquire this particular kind of a landscape mosaic, two cumulative conditions must be met:

- Conservation must be sought over large areas (**landscape approach**), to allow for presence of large enough, well-connected, various habitat conditions (i.e. various stages of stand development) which should accommodate vigorous populations of desired species;
- The landscape must contain, at **all times, all stages** of stand development, in a relatively **balanced proportion** at landscape level (for equal share among species with different needs).

As large areas without human presence are not available, forest management is a reality that cannot be overlooked. Therefore, to meet the first condition, the economic and social aspects must be part of the solution. Moreover, the balanced and diverse structure of the mosaic requires a more regulated disturbance regime. This seems to be more viable under a controlled management than by natural disturbances alone, especially considering the impacts of climate change.

Taking into account all features which ensure a high biodiversity across dynamic forested landscapes, it is worthwhile to discuss whether such conditions are met across Romanian forests, which are well known for their high biodiversity of plants and wildlife.

The high biodiversity of Romanian forests

Romania is blessed with five different biogeographical regions: Pannonian, Steppic, Alpine, Continental, and the Black Sea. These provide very different environments, ranging from the heights of the Carpathians to the Danube Delta and the Black Sea. Therefore, this natural heritage provides good conditions for biodiversity at a large scale. In addition, a very diverse vegetation cover can be found across the altitudinal and latitudinal gradients.

[11]Species that depend on a certain forest structure or development stage, e.g. the woodpecker.
[12]Species relying on different structures for different needs - feeding, hiding, thermal cover, mating etc., e.g. the red deer.

In terms of the forestland, despite being under continuous regulated management for more than a century, Romania's forests are highly diverse. Diverse native tree species assemblages range from the open oak woodlands in dry lowlands and riparian forests in the flood plains to mixed deciduous forests on the hills and all the way up to the closed and dark European beech and Norway spruce pure stands on the heights of the Carpathians. In addition, these forests with natural compositions have quite diverse structures both in terms of the canopy (uniform, relatively uniform, relatively diversified, diversified) and age (from young to very old – providing a mosaic of different age classes in the landscape). Moreover, the old forest stage (usually over 100-140 years of age) is constantly present in the forested landscape mosaic. Together with the special case of the old-growth (more than 300-400 years of age) and virgin forests, they offer important habitats for some specialized species. Also, long periods of tranquility are ensured for animals in large, compact areas in all forests. The transition from the old forest stage to a young regeneration is either gradual (most of the time), producing temporary intermediate conditions between closed forest and open environments, or sudden (less common).

Apart from all these considerations, the forestland area in Romania has remained relatively stable (around 30% of the country) even increasing slightly (as mentioned by Nicolescu in section 1.1 of the book), and still provides a very good spatial connectivity. For example, a 1 km buffer distance (which fulfills connectivity needs for most species – Opermanis et al. 2012) connects forested patches of various sizes, but larger than 25 ha, in one cluster of 6.076.055,32 ha (85% of all forests), concentrated around the Carpathians. Together with 11 more clusters larger than 10.000 ha, existing in other parts of the country, the percentage of well-connected forestland becomes approximately 91% (Stăncioiu et al. 2018) (Figure 1.10).

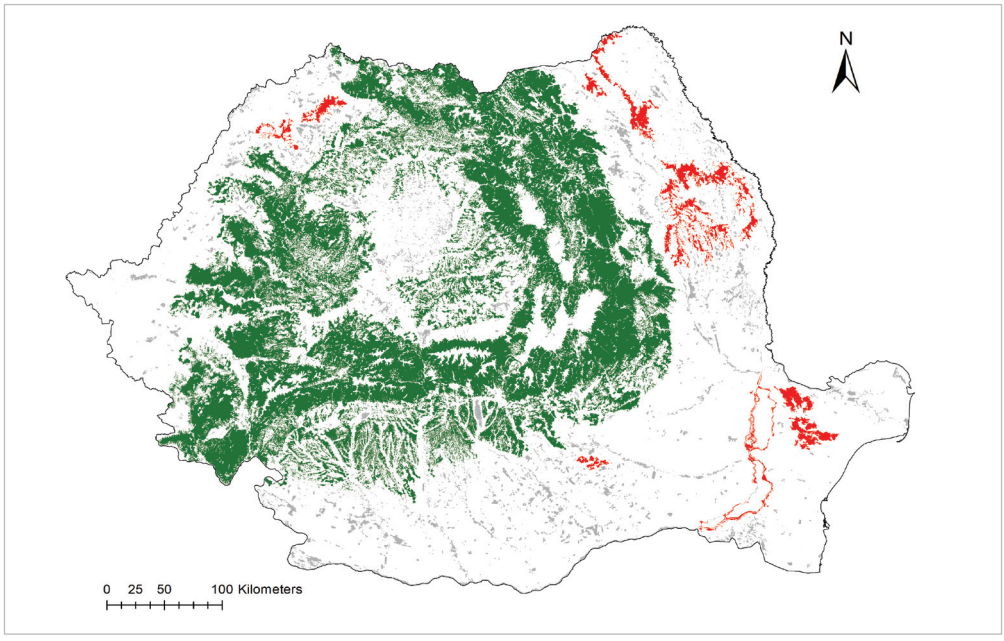

Figure 1.10 Forestland connectivity in Romania, for a threshold distance of 1 km (green – the largest cluster around the Carpathians; red – another 11 individual clusters cumulating over 10.000 ha each; grey – the rest of the forestland, clusters below 10.000 ha and unconnected forests)

Moreover, the forest biodiversity in Romania is widespread across the entire country not only within the diverse types of protected areas (national and natural parks, sites of community interest, special conservation areas – SPAs, natural reserves, nature monuments, UNESCO Heritage sites) which cover altogether only approximately 24% of the national territory (Figure 1.11).

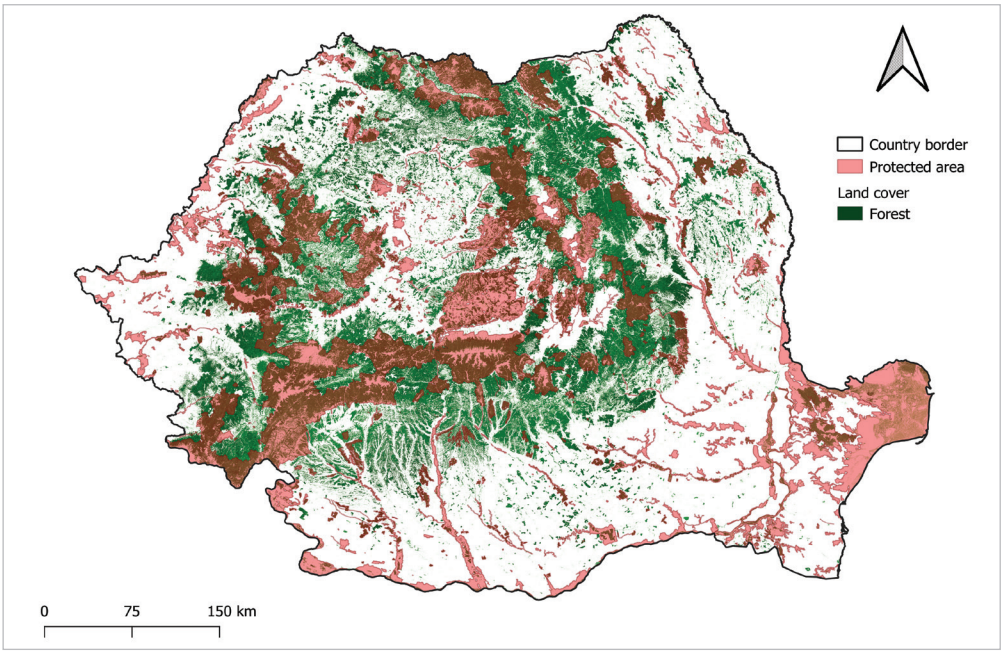

Figure 1.11 Map of forestland and protected areas in Romania

As this high biodiversity of the Romanian forests is not something new or acquired overnight, it becomes highly important to understand how it has been achieved in order to decide what should be done to maintain such a favorable situation. It is therefore important to analyze and understand the national context ensuring this favorable status. Which are the particular forest management approaches favoring biodiversity? Understanding these would also support the implementation of new concepts in natural resource management (e.g. bioeconomy) while still maintaining the high biodiversity of Romanian forests.

Why are Romanian forests so biodiverse?

As mentioned earlier, the diversity of natural environments is a requirement for species diversity. And therefore, the natural heritage of Romania explains at least partially the high diversity of species. However, other European countries have such diverse geographical conditions but still do not harbor a similar diversity as the one found across Romanian forests. Moreover, forests are mostly present only in two of the biogeographical regions (i.e., the Alpine and the Continental). Therefore, the land management of this natural heritage can be credited for ensuring the necessary conditions favoring the century-old and large-scale biodiversity of Romania. In terms of the national forestland, as forests were under regulated management at

national level for more than a century, the link between forest management and biodiversity conservation must be acknowledged. In order to understand the special characteristics of Romanian forests, it is first important to understand the particular forest management approaches that favor such a large-scale, mosaic-like forested landscapes with high biodiversity.

Romanian forest mangement is tightly regulated by the state and implemented in a complex framework of management planning and implementation according to a single set of technical norms (as mentioned by Nicolescu in section 1.1 of the book). Among the many forest management rules, at least some which favor presence and maintenance of natural and diverse habitats, deserve further attention. A correspondence between the most important habitat requirements for high biodiversity and silvicultural rules ensuring these is presented in Table 1.6.

Table 1.6 Different silvicultural rules and their associated biodiversity outcomes

Silvicultural rules at national level	Effects ensuring high biodiversity
• Natural forest types maintained by regenerating local tree species mostly through repeated cuts (shelterwood). Clearcuts are restricted to areas less than 3 ha and allowed only in some pure spruce forests and in artificial plantations.	• Diverse tree species assemblages, matching natural compositions of the ecosystems • Local provenance for regeneration ensuring resilient ecosystems
• Natural tree species composition of stands is imposed by norms also for plantations (where natural regeneration is not possible or has failed).	• Gradual transition (most common) from old to young forest and sudden transition (less frequent)
• Silvicultural treatments imposed by norms (**according to state objectives not the owners' objectives**) and adapted to the functions attributed to a stand (see section 1.1. of the book).	• Diverse canopy structures (uniform, relatively uniform, relatively diversified, diversified)
• Principle of sustained yield (proposed by G. L. Hartig in the 18th century) is imposed by norms for all owners and seeks to obtain a balanced proportion of age classes within the management unit.	• Provide conditions for a balanced proportion (mosaic) of different age classes (from young to very old) in the landscape = provides very diverse habitat conditions
• High-forest systems with long rotations (over 100-120 years) are imposed by norms and prevail in the national forestland. Virgin and old growth forests are protected.	• Old forest stage (usually over 100-140 years plus special cases of old growth forests > 300-400 years) constantly present in the mosaic, thus providing habitat for the specialized species
• In all managed forests, a tranquility period is imposed before starting the regeneration cuttings (only sanitation cuttings allowed in the last quarter of the rotation; this quarter usually starts when forests are 80-90 years old)	• Long periods of tranquility ensured for animals on large, compact areas

Silvicultural rules at national level	Effects ensuring high biodiversity
• Strict control by law of land-use changes in the case of forests and high costs for such land-use changes (including 3 times larger forested areas for compensation).	• Maintenance of forestland area integrity (control of land-use change) and even increase of the forested area • A well-connected forestland at large scale[13]

Not only the rules themselves are important for biodiversity but also the fact that they have been applied continuously for the last seven decades (and even more in some places) and **at the country level, regardless of land ownership** type, thus producing similar results at a national scale. This particular management of the natural heritage ensured the widespread and spatially-connected biodiversity across Romania, in and outside the existing protected area network. It should be stressed that most of these rules are imposed for environmental objectives and not for timber production or economic profitability. As mentioned by Nicolescu in section 1.1 of the book, any forest stand in Romania is assigned either to a special protection function or to a production and protection function; never to production alone.

Current challenges in maintaining a high biodiversity

Although effective in terms of biodiversity, this restrictive and intricate approach to forest management requires intense efforts and incurs very high costs. Romanian forestry is therefore less profitable in comparison to other sectors in terms of economic revenues. Such high costs are probably among the reasons why this system was not embraced by other European countries, with similar richness of geographical conditions but lower biodiversity. Lately, however, the objective to reduce these costs has become a threat to maintaining the biodiversity-friendly system described above. Besides the cost effectiveness of the forest management system, some other challenges have risen, and they should be carefully addressed.

One of these challenges is the recently defined goal of the European Union, through its Biodiversity Strategy[14], to approach conservation through the lens of strict protection. This goal may have the negative effect of actually diminishing biodiversity at larger scales. The strict protection approach, while removing management from some places, would shift the economic burden to remaining areas, formerly under more protective but less intensive management. This in turn would transform the more balanced shifting steady-state mosaic existing now at the country level into a sparser and much smaller area deployed for effective biodiversity conservation. Even on such protected lands, the strict protection excluding only human impact, will not prevent the change produced by natural disturbances such as windthrows, fires, and insect outbreaks. Such disturbances are even more intense and more frequent under current climatic conditions. Therefore, such strict protection would most likely not reach the desired impact on biodiversity at a large scale. Another risk associated with strict protection is that it tends to neglect important aspects related to ownership and access rights, thereby threatening

[13]This objective is also ensured by all other rules mentioned in the table which offer not only spatial continuity of naturalness of habitats but also continuity of feeding, hiding, migrating conditions for animals.
[14]https://ec.europa.eu/environment/strategy/biodiversity-strategy-2030_en

livelihoods and hampering rural development. Needless to say, such a strict approach will ultimately affect the feasibility of transitioning to a sustainable forest-bioeconomy.

Besides the growing need for bio-based resources (partly driven by the bioeconomy) and the tendency to increase the strictly protected land (to fulfill the EU Biodiversity goals), other factors might have an important influence on the current status of forestland in this part of Europe. Although biodiversity is still well represented in terms of species, population sizes, and spatial distribution, and the forestland has slightly increased, two additional relatively recent challenges could determine important changes in the long term:

- changes in land ownership due to restitution laws, and
- changes in land-use such as plans to develop large infrastructure i.e., highways and industrial sites; other changes include expanding urban and rural areas, as well as the development of touristic facilities in natural areas.

Whereas large infrastructural development is still low and does not severely affect the forested area so far, the restitution that took place over the past decades affected a large proportion of forestland. This restitution process confronted the new owners with important challenges. For example, the high costs of forest management imposed by the state put high financial pressure on forest owners, especially on the small ones. More specifically, the costs for the management carried out only by authorized entities and for the management planning carried out by specialized third-party companies are borne by the owner. The complex and costly forestry rules (i.e., management restrictions and ecological constraints) yield low profitability for forest owners. The absence of appropriate compensations or incentives coupled with crippling regulations has affected the willingness of new forest owners to abide by the rules. Even more so, an improper law enforcement capacity at the time of restitution has led to inadequate management practices, especially on small properties. As a result, around 300.000 ha have been illegally logged (The World Bank 2000). Although nowadays illegal logging activities are less common, the lack of incentives/compensations for covering the high costs of traditional management on private lands is hampering their financial viability.

Conclusions

In order to enable the successful transition to a sustainable forest-based bioeconomy, forest management and biodiversity conservation need to be integrated. In this regard, finding a balance between exploitation and conservation is crucial. The high, widespread, and well-connected biodiversity of Romania exists thanks to *close-to-nature* forest management. In fact, the presence of vigorous and widespread populations of plant and animal species considered threatened in other parts of Europe, including some flagship species such as large carnivores, bear witness to the fact that conservation and land management were successfully integrated for a long time in this part of the continent. This also proves that a successful coexistence of humans with natural biodiversity is possible. This coexistence can be achieved by actively managing large-scale landscapes, which is a viable tool for biodiversity conservation that does not ignore the needs of local communities whose livelihoods depend on these landscapes.

In conclusion, transitioning to a forest-bioeconomy is possible under smart resource management. The successful integration of this new concept with the conservation of biodiversity in one of the European Union's most biodiverse states needs complex but smart solutions. The challenge remains to decide between:

- the integrated approach = with the advantage of applying sustainable management at

a large scale for a shifting steady-state mosaic at the country level (already successfully implemented in Romania for decades). The disadvantage of this approach is its high costs.

- the segregated approach = spatially scattered protected areas embedded in forests landscapes managed for intensive production (more common to other parts of Europe, where the biodiversity is much lower compared to Romania).

The integrated approach has already proven its effectiveness for several decades. However, important political, social, and economic challenges must be overcome for its implementation at a wider European scale. To be viable, policies and management decisions should be well adapted to the specific national, regional, and local contexts, and should not follow a "one-size-fits-all" approach (Aggestam et al. 2020).

Take-home messages:

- Sustainable forest management could ensure the controlled, well-connected, shifting steady-state mosaic needed for the survival and perpetuation of all species. Such a mosaic would not only ensure the presence of all types of habitats in order to achieve the largest biodiversity but could cover much larger and better-connected areas than those included under strict protection. Moreover, it can accommodate the needs for renewable resources needed for a strong and sustainable bioeconomy.
- The diverse structures needed to achieve high biodiversity require very diverse silvicultural interventions. These tools should not be judged by the aesthetics of their outcome (Kimmins 1999, Kimmins 2001), except for cases when the aesthetic value is part of the management objective. If biodiversity is the goal, tools should be chosen based on their adequacy to achieve this value. Close-to-nature should be indeed close to what nature does and what nature needs i.e. a wide array of natural disturbances catering to the needs of multiple species.
- Complex management for biodiversity conservation in the context of bioeconomy requires a thorough understanding of the forests and their dynamics. It also incurs very high costs. Efficient and inclusive conservation needs to be achieved in partnership with local communities. Therefore, incentives and subsidies must be provided not only to compensate the rightful owners and cover the administration costs but also to ensure a fair transition for forest-dependent communities. Moreover, subsidies need to reach the actors that actually support the costs and carry the burden (landowners and managers – the true stewards of the land).
- Other countries could learn from both the strengths and weaknesses of the Romanian model of integrated forest management. Policies and especially final decisions in forest management should be based on the specific national, regional, and local context. Ignoring the complex political, environmental, economic, socio-cultural European context and pushing for a "one-type-fits-all" approach will be counterproductive and ultimately unsuccessful.

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1.3 How to Balance Forest Management with Wood-use for a Climatically Neutral Economy?

Viorel N.B. Blujdea

Introduction

Across the national economy, there are four wood pools: two are natural but managed (standing living biomass and deadwood), and two are fully anthropogenic (wood products and wood waste). Due to its versatility, wood can be used in four competitive forms: volume (i.e., shape and dimensions of logs), energy (i.e., energy content), biomass (i.e., chemical composition), and carbon credits (i.e., participation in emissions reduction schemes). We focus here on harvested wood products (HWP), where we try to understand the long-term impact of the stored carbon by using wood.

The amount of carbon deposited in the HWP reservoir at a certain moment in time, for a specific administrative boundary, is the result of the balance of annual gain and annual loss. In the case of wood products reservoir, a long-term, annual constant gain leads to an increase in stock for a limited period of time only; the HWP reservoir would eventually convert to a source, due to the lifetime of the actual wood products.

In Romania, the economy's drop post-1990, its boom between 2004-2007 and industrial roundwood distortions post-2007 had a significant impact on the dynamic of the harvested wood product (HWP) reservoir; resulting in a decade-long absolute CO_2 emission in the first case. The wood products sink represents approximately 10% of the annual sink of Romania (e.g., about 24MtCO_2 per year as of Romania's report to UNFCCC).

Under a "business-as-usual" (BAU) scenario, the carbon stock stored in Romania's wood products would almost double in the following 40 years, reaching around 80 MtC (million tons of carbon) compared to 50MtC in 2019. Sourcing roundwood from domestic forest only (i.e., the "counterfactual scenario"), would have a sink effect for HWP pool from 2MtCO_2/year in 2021 down to 0.5MtCO_2/year toward 2060, compared to business as usual (BAU). The application of the measures with slow onset and increased allocation of roundwood to harvested wood products ("High HWP scenario") – to reach 70% of currently installed industrial wood processing capacity by 2030, with the continuation of roundwood import and export at current rate – would allow the maximization of the HWP sink from an additional 4MtCO_2/year in the immediate future to around 2 MtCO_2/year in 2060, compared to BAU.

However, given the lack of reliable data on timber harvests in Romania, the interaction of HWP scenarios with forest sink modelling cannot be substantiated. While "business-as-usual" and "counterfactual" scenarios can be accommodated within the current harvest level, "High HWP" may have a very significant impact on forest sink, leading to a substantial reduction of forest sink by 10-12 mil. tCO_2 annually, compensated by roughly only 4 MtCO_2 sink in HWP. This negative impact on the forest sink may be slightly alleviated through substitution, if the bioeconomy takes over wood originally designated for traditional uses, including burning biomass for energy. Traditional and novel HWP pathways would likely result in a competitive use across the line volume-energy-biomass-carbon, still in need of assessment through future efforts.

Background

The United Nations Framework Convention on Climate Change (UNFCCC) aims to achieve the "stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system" (UNFCCC, 1992). In practice, this means a global framework for monitoring, reporting and eventually reducing emissions of greenhouse gasses (GHG) from anthropogenic activities. Generally speaking, reducing emissions means a permanent removal of CO_2 from the atmosphere or a reduction of GHG emissions from economic activities. Under this framework, forestry activities are included in the land use, land-use change, and forestry (LULUCF) sector. Reporting GHG emissions and removals from the forestry sector is part of the national GHG inventory submitted to UNFCCC annually since the first reporting began in 2002. But the actual participation of LULUCF sector to emission reduction schemes was agreed much later compared to other sectors, and through a limited list of eligible activities (e.g., afforestation through Marrakesh Accords in 2001(UNFCCC, 2001)), and was included in the reporting from 2010. Furthermore, the mitigation by management of long-term wood products, the so-called harvested wood products (HWP) was first voluntary, and it only became mandatory since the implementation of Decision 2/CMP7 (Durban, 2011), during the reporting year 2015.

HWP includes the pool of products made from wood which are "in service" (i.e., in actual use), or dumped (i.e., deposited for an indefinite period without being in any actual use), existing within a certain spatial boundary (i.e., national scale under UNFCCC). According to the Intergovernmental Panel on Climate Change (IPCC) (2006, 2013), there are three types of semi-finite products which best reflect the actual amount of wood existing as HWP: sawnwood, panels and paper, and carton-boards. These three semi-finite products represent the level along the wood processing chain where double accounting is negligible (IPCC, 2014). IPCC defines HWP as a reservoir, in order to differentiate it by the carbon pools which exists naturally (e.g., soil or dead wood). According to current reporting rules for GHG emissions, all HWP related emissions occur at the end of life of the wood products. In reality, some wood is transferred to the waste pool, where indeed only non-CO_2 emissions are estimated and reported.

The degree of anthropogenic control varies across the four existing wood pools: living biomass, dead wood, wood products, and wood waste. Acting on these pools provides for GHG mitigation actions. The carbon amounts and dynamics in standing living biomass and dead wood, whether standing or laying, are the result of forest management options and practices. By contrast, the deposits in products and waste are fully controlled anthropogenically (through use in conditions that delay their decomposition).

In principle, the dynamic of biomass in wood products follows the pattern of the decomposition of the organic matter in nature. It is expressed mathematically as an exponential curve, i.e., losing weight at a time-bound rate. The default approach in the GHG inventory relies on the first-order decay function (FOD) driven by the half-life of the product (IPCC, 2006). Thus, the longer the life of the wood product, the longer the delay of the emissions from the product's decomposition. For example, produced in the same moment, the paper would decompose faster (2-4 years) than construction wood (60-100 years). Manipulating wood results in emission reductions not necessarily from using more wood than the wood used for traditional applications, but from the substitution of various other products across the economy. The latter may result in significant emission reductions, in addition to carbon being stored in additional wood products.

In essence, the forestry sector operates on "volume", i.e., standing volume and annual increment in m^3, while the climate change process operates on dry biomass and carbon stocks, stock change, and fluxes of C from/to the atmosphere as CO_2 emissions to, and CO_2 removals from atmosphere. Biomass, as fresh matter, is rarely used as a metric. In fact, as a general rule, the conversion of volume to biomass implicitly accounts for the conversion from fresh to dry matter through the way wood density sampling and processing are performed. Roughly one m^3 of raw roundwood equals one tCO_2, depending on the tree species' dry wood density, share and characteristics of bark, and by including in calculation the C content of wood (ca. 47% as of IPCC (2006)) and C to CO_2 factor (ca. 3.666). While true for a roundwood feedstock, the ratio may go up to more than $4tCO_2$ per $1m^3$, depending on the actual forestry and indicators involved; e.g., if standing stock associates to entire aboveground woody part or only standing commercial wood, and for fluxes, e.g., increment, harvest.

Under the UNFCCC process, every nation as a Party to UNFCCC, reports a national GHG inventory which provides quantitative information on how forest land contributes to the atmosphere's GHG composition, i.e., through the CO_2 and non-CO_2 fluxes to (i.e., emissions), or from (i.e., removals), the atmosphere. In such reporting, the use of wood is reported by sources across different sectors of the economy: energy (for heat and power (H&P)), land use (CO_2 attached to changes in ecosystemic deposits) and waste (discarded wood products). Moreover, the use of wood has an indirect component through substitution across all sectors of the economy.

UNFCCC related reporting of wood involves general conventions which rely on IPCC principles including that: i) emission has to be reported at the source (e.g., wood harvest is a loss of carbon from forest land); ii) avoid double reporting of emissions and removals among the sectors of the economy, and iii) wood use is attached to the sector showing the most uncertain estimates (forestry and land use) and is not linked to other economic sectors. The most prominent example is that the energy sector does not include a total estimate for CO_2 emissions from burning wood, as this was already reported as an emission by the land use sector (indeed Energy only reports non-CO_2 emissions from biomass burning). Secondly, CO_2 emissions occurring from wood waste are accounted for by the HWP reservoir instead as waste where they actually occur, while only non-CO_2 emissions are reported by waste. On the positive side, when other sectors make better use of wood, this is reflected in enhanced HWP storage and modified emission patterns, rather than being accounted for by those sectors.

The focus of this paper is on understanding the balance of emissions and removals from the HWP reservoir in Romania, considering the impact of harvesting and using roundwood from domestic forests. Mitigation options are analyzed based on Kyoto Protocol's Doha Amendment (UNFCCC, 2012) and EU LULUCF Regulation (EU) 841/2018 requirements (European Commission, 2021). Nevertheless, the heavy uncertainty on harvest and other forest related events limits the analysis of the impact of various HWP policies on forest sink dynamics across the entire LULUCF sector.

Concept, methods, and data

Method for the estimation of CO_2 emissions and removals in HWP

From a mitigation perspective, we will calculate the amount of net removals by using the "IPCC production approach" (IPCC 2006, 2014, 2019) which is consistent with Romania's

commitments under the Kyoto Protocol's Doha Amendment and the EU LULUCF regulation. This method allows an estimation of sink or source in the HWP reservoir in a year based on the balance between annual C gain, (i.e., due to manufacturing of new wood products) and annual C loss caused by the decay of historical inputs into the pool which started in 1900. In order to avoid overestimation of the current sink, the method requires the reconstruction of C stocks back to 1900 following the IPCC methods (IPCC, 2006). Specifically, the IPCC methods rely on FOD to characterize the loss from the pool. Other methods for example, would consider discount factors built from historical wood products dumped currently as waste, applied to the current year of wood waste production (e.g., Skog and Nicholson, 2000), or correction of the current year inflows into the HWP pool by future emissions assuming 100 years of lifetime for the products (e.g., Miner, 2006).

The "production approach" attributes the CO_2 emissions or removals resulting from the use of wood products from domestic sources (IPCC, 2006, 2014) to the reporting country. Noteworthy is the fact that it explicitly excludes exported roundwood from the accounting, whose fate at the destination is not known. Thus, implicitly imported roundwood is also excluded. By contrast, exported wood products are accounted for by the exporting country.

Data used

The data used here were represented by major types of wood commodities: industrial roundwood and fuelwood, as well as the three aggregated semi-finite products. They are retrieved from FAOSTAT (http://www.fao.org/faostat/en/#data/FO) for the entire time series available, e.g., since 1961. Assuming a "business-as-usual" scenario, a slight upward trend of the industrial wood demand following the 2010-2019 trend can be expected, while the fuelwood is expected at the same level assuming the improvement of energy efficiency and alternative forms of energy take over wood use in the heat and power sector (Figure 1.12).

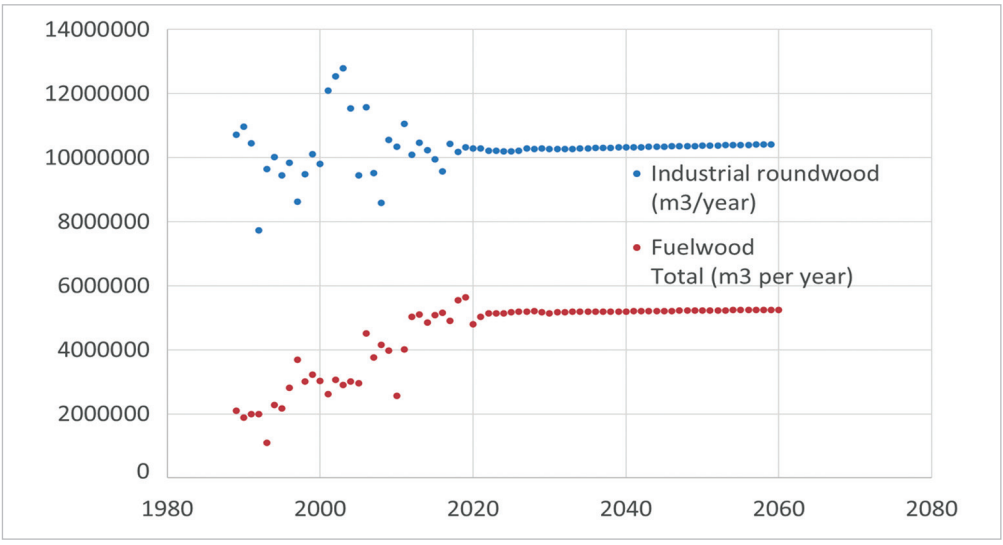

Figure 1.12 The production of industrial roundwood and fuelwood from domestic forests, based on FAOSTAT, and projections by 2060 assuming the average trend recorded during 2010-2019

Noteworthy, Romania's data reported by FAOSTAT appears to be estimated by FAO based on "imputation methodology", a data gap-filling method. Thus, the data is not submitted by the country. Half-life values are 35 years for sawnwood, 25 years for panels, and 2 years for paper, according to IPCC (2014).

Further on, we make the assumption that there is no roundwood sourced in deforestation, for which reason our estimates represent, most likely, an overestimation of the HWP potential under the accounting framework, though the estimates stay valid from a national GHG inventory perspective. The underlying cause is the lack of reliable data on deforestation, as Romania reports around 7,100 ha of deforestation per year (UNFCCC, 2021), which is most likely an overestimation (e.g., an independent assessment, like https://www.globalforestwatch.org/, allows deriving smaller numbers for the post-2000 period). Using that deforestation area would result in a roundwood removal of about 18-19 Mm^3 per year which constitutes the total harvest reported officially by NIS (assuming an average 339,8 m^3/ha according to NFI, http://roifn.ro/site/rezultate-ifn-2/). Only when scientifically robust data on deforestation becomes available, the accounting of GHG by HWP can become reliable and credible.

Finally, we also make the assumption that the entire amount of wood reported originates in forests, so the contribution from other land use categories is implicitly negligible.

Competitive use of wood within the limited wood resource

Wood is a limited resource, according to applicable sustainability rules in forest management. Within that, the industrial roundwood (IRW) is an even more limited resource. IRW share in the standing stock is in fact the consequence of past silviculture (as it determines the current quality of logs) and wood harvesting practices (which may further reduce the quality of logs). We operate here with a classical IRW definition whereby roundwood displays certain qualities and dimensions adequate for industrial processing, while these may change in the future (to include any available biomass type). In effect, novel applications and technologies value solid biomass as much as traditional volume or energy-based applications. This analysis reflects *the four key metrics* attached to wood use: *volume, energy, biomass and carbon content*:

- *volume* of roundwood as the primary product of forest management. Fundamental features are the piece shape and dimensions (length and diameter) allowing the use of roundwood in its natural form or technologically modified and improved forms. This includes site and species related aesthetic and technological properties;
- *energy content* is rather similar across species for the same weight of dry matter (indeed the volume is very different), while water content at the burning moment makes a big difference. Compared to fossil fuels, such a source is generally qualified as being of renewable origin. Notably, the shape of wood pieces does not matter;
- *biomass*' chemical composition, e.g., mainly justified by the cellulosic and lignin balance, or mineral elements content (e.g., higher in bark). The amount used for non-energy purposes (e.g., textile, paper), to supply the forthcoming increasing bioeconomy. Notably, the shape of wood pieces does not matter either, nor does the ratio of bark to wood;
- *carbon* content – a combined feature accounting simultaneously for the fact that wood products are part of a reservoir of carbon on various time frames, and for the fact that it provides for emission reduction through wood products and substitution of other

energy or material intensive materials across the entire economy, thus contributing to the global effort to mitigate climate change. This feature is dependent on policy instruments promoted as market mechanisms (e.g., price, direct incentive) or eco-instruments (e.g., labelling, GHG emission permits).

The actual use of wood products operates along these four metrics, i.e., pathways which can result in immediate or delayed emissions. Simultaneity of the four features would most likely provide for a significant competition in the wood use given limited availability (e.g., by increased biodiversity and nature conservation concerns).

Assumptions and caveats regarding the CO_2 sink in Romanian forests

Contradictory information is available on forestland C stocks and CO_2 sink in Romanian forests (e.g., UNFCCC 2021, FAOSTAT, 2021). The key reason for this is that there are various figures advanced for roundwood removals from forest: around 18 mil. m^3 as of National Institute of Statistics (NIS) and around 38 mil. m^3 by National Forest Inventory (NFI). Some publications have shown intermediate estimates based on preliminary NFI data as available in 2016 (Blujdea and Marin, 2018). Moreover, the other fundamental parameter of the sink calculation is the net annual increment, for which, again, two estimates are available, one from NFI, another from NIS. Officially, Romania reported to UNFCCC (UNFCCC, 2021) for year 2019 a sink of approx. 24 mil tCO_2 for forestland to which it added a net removal of approx. 3.85 $MtCO_2$ by HWP reservoir. Interestingly, Romania reports under the Kyoto Protocol a net removal of approx. 29 mil. tCO_2 only from land subject to forest management activity. Moreover, under the same Kyoto Protocol, Romania reports a reference level of 15,793 mil tCO_2, enabling the country to account for removals under its second commitment period. Therefore, a simple arithmetic between corresponding sinks in the inventory and accounting raises an important question, namely: what justifies the large difference between forestland sink and the net removals accounted from forest management. The numbers reported in the previous years are of similar order of magnitude. We use these numbers as a reference for our analysis, while we do not discuss their consistency.

Scenarios of using roundwood and production of semi-finite products

The three scenarios shown here are far from being exhaustive, rather they represent a theoretical exercise (Table 1.7). This exercise builds on the assumption that the figures for *reported use*, e.g., by the wood processing industry, *and trade*, i.e., import and export of roundwood and semi-finite products, are far more reliable than *reported fellings*, e.g., standing biomass subject to thinning and final cuts reported on forest registry, *and reported removals*, e.g., roundwood harvest from forest (Johnsson et al., 2021). Further on, contradictory information on the amounts of wood removals from the forest (NSI vs. NFI) and fuelwood used, prevents the discussion of a reasonable substitution scenario or forest sink assessment in the context of the HWP dynamic. Consequently, the dynamic of the HWP reservoir is only assessed under three scenarios, excluding substitution.

These scenarios are designed around three major assumptions built upon the officially reported data: a) roundwood sourced domestically, import and exports of roundwood, b) production of semi-finite products as commodities (sawnwood, panels, and paper), and c) export and import of roundwood and semi-finite wood products.

Table 1.7 Three scenarios regarding the feedstock and use of industrial roundwood for 2020-2060. Source data is valid for 2019 or averaged over 2010-2019. Industrial roundwood (IRW) refers to solid wood under-bark of industrial quality (including pulpwood), which, together with firewood sourced in forestland, represent the roundwood removal from forest. All three scenarios assume there is no roundwood associated to deforestation. All values are rounded to the nearest integer.

Scenarios	IRW feedstock assumptions	Contribution to country's GHG balance and accounting
Business-as-usual IRW supply ("BAU")	The current level of use by the industry remains unchanged. IRW feedstock continues until 2060 the trend demonstrated over the last 10 years, i.e., 3% higher in 2060 compared to 2019. The total feedstock is 11.1 million m^3 per year, out of which 48% coniferous and 52% broadleaved species. This includes the domestic production of 10.3 million m^3, import of 1.1 million m^3 and excludes the export of 0.2 million m^3 per year. Import of IRW is assumed fully of sawnwood quality (Panaite and Bouriaud, 2020). Over the last decade, in average, semi-finite products split as 54% used for sawnwood, 43% for panels and 3% for pulp. From 2010 on, there was no domestic production of pulp wood, as reported by FAOSTAT, while the production of paper and paperboard still represents some 500kt per year (likely from imports, by-products and/or paper-recycling, although it cannot be determined).	Only 81% of the annual inflow of C in the HWP reservoir is accountable by the national forestry sector, as sourced in wood removed from domestic forests. Forestland sink would remain at the historical level.
"No import" and "no export" of roundwood with respect to national boundaries ("Counterfactual")	The current level of wood use by the industry remains unchanged. Starting from 2020 until 2060, the total amount of IRW estimated for BAU scenario, 11.1. million m^3, is only sourced from domestic forests. This scenario is likely to be very unrealistic given the free market of wood products within the EU, but it provides for a "what if" counterfactual scenario for policy making, e.g., accounting the HWP in the EU as a whole, rather than at national scale.	100% of the annual inflow of C in the HWP reservoir is accountable by the country. This scenario may not imply a reduction of the forestland sink, i.e., an increase of fellings from forest, but it would rather represent a wood quality-based optimization of some 1.3 million m^3 of roundwood allocated currently as firewood, increased share of roundwood by the same harvesting, etc.
Increasing annual IRW feedstock ("High HWP")	By 2030 a steady increase of wood use by the industry by up to 85% of the currently installed capacity of 18.7 million m^3 (Panaite and Bouriaud, 2020), and maintained at this level afterwards. This means IRW processing would reach a level of some 16 million m^3 per year from 2030 on.	95% of the annual inflow of C in the HWP reservoir is accountable (difference of 5% is related to roundwood imports). Most likely such a level would not be possible without additional 4-5 mil m^3

Scenarios	IRW feedstock assumptions	Contribution to country's GHG balance and accounting
Increasing annual IRW feedstock ("High HWP")	This is consistent with an increase of production by some 50% across all semi-finite products, with the exception of paper and paperboard which is assumed to remain at current level until 2060. Imports and exports of IRW are maintained at the same level as in BAU; we believe this is a realistic approach rooted in the economic and trade reality. This option would certainly include new market products, e.g., biomass based (e.g., related to wood chemical properties), rather than volume based.	of industrial roundwood harvest from domestic forests, annually, (once the harvest is clarified, and such a scenario needs to be tested). This would reduce the forest sink by some 10 million tCO_2 annually, or accordingly less, assuming further wood quality-based optimization, including through better use of fuelwood (and replacing fuelwood with other energy sources), and better wood processing technologies (e.g., in terms of wood species, or wood dimensions), and biomass.

Results

The C stock in the HWP reservoir is the result of the balance between annual gain (e.g., additions of new products) and an annual loss (e.g., end life discarding as waste, burning, or recycling or direct CO_2 emissions through decomposition). Specific to the HWP reservoir is that a constant input annually results in an increased stock for a limited period of time only (see "stock in the year" in Figure 1.13).

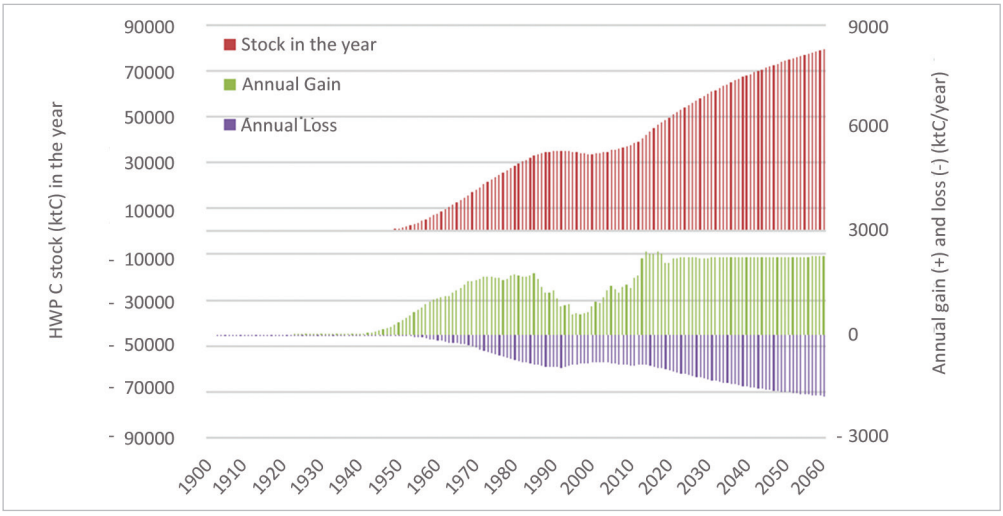

Figure 1.13 HWP carbon and CO_2 dynamics under the BAU scenario assuming the current level of wood processing, import, and exports of roundwood until 2060. In red, the total C stock in HWP (50 000 000 tC,

roughly equiv. to 175 000 000 m^3 of roundwood). In green, is the annual gain, and in blue, the annual loss from the HWP reservoir. The lows in post-1990 and around 2010 are caused by the economic crisis, while the ups from post-2012 to global recovery. A positive number represents an increase in C stock, while a negative one represents a decrease in C stock.

The HWP reservoir eventually would convert to a source; it is all a matter of time and the length of life of the actual products. It will happen earlier for HWP dominated by products with short life, and later if products are long life. This can be counterbalanced through climate-oriented management of HWP, e.g., recycling of old HWP to new products through cascading use. All the three scenarios result in an increase in C stock until 2060 (Figure 1.14).

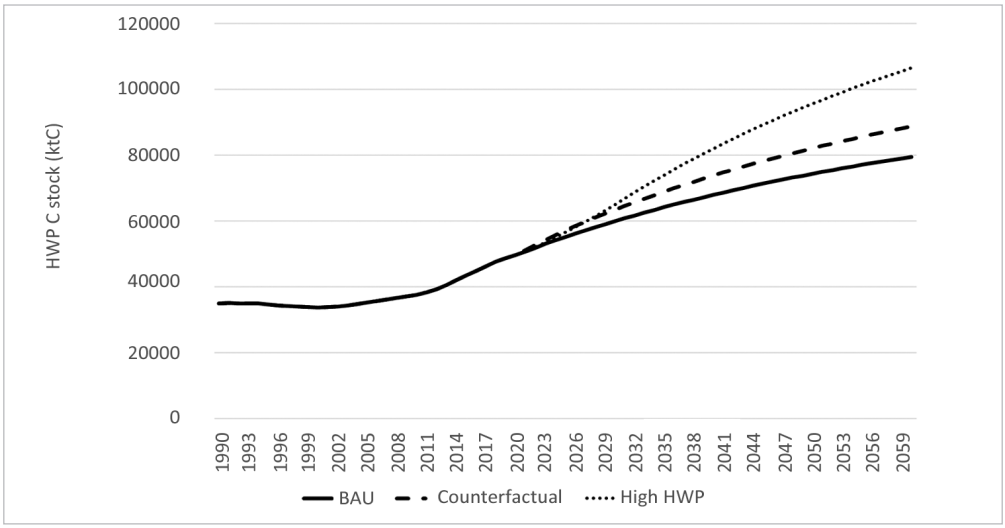

Figure 1.14 Dynamic of C stocks in HWP under the three scenarios. Upgrade slope denotes a gain-loss balance influenced by dominance of the gains during the period, contrary to downgrade slope where the losses dominate.

Under BAU, the C stock would almost double in the following 40 years; this is because the annual gain would be larger than the loss. The gain-loss balance results in an annually decreasing net gain in HWP from 1.2 MtC in 2020 to 0.4MtC in 2060, and, assuming the same constant input, it would turn HWP reservoir into a source after several decades, around 2080. The "counterfactual" scenario seems to represent the best solution in the short term only, e.g., comparatively 1MtC more stored annually until 2035. Among the three scenarios, "High HWP" shows a benefit on both short and, especially, on longer-term.

"HWP sink" represents a higher gross gain than gross loss during the year, i.e., a net gain of the C stock in HWP, which is conventionally equivalent to removing CO_2 from the atmosphere. Toward 2060, the HWP reservoir would stay as a sink under all scenarios, although "High HWP" provides for the most significant effect (Figure 1.15).

The HWP sink dynamic is related to major economic events in the country: the economy's drop in post-1990 resulted in HWP being a source for almost a decade, until year 2000. On the one hand, distortions of industrial roundwood supply from both internal and EU market impacts on the HWP sink. This explains the drop from post-2017 (ASFOR, 2021). On the other hand, the economic boom after the 2008 crisis is associated with a significant sink in 2014-2017.

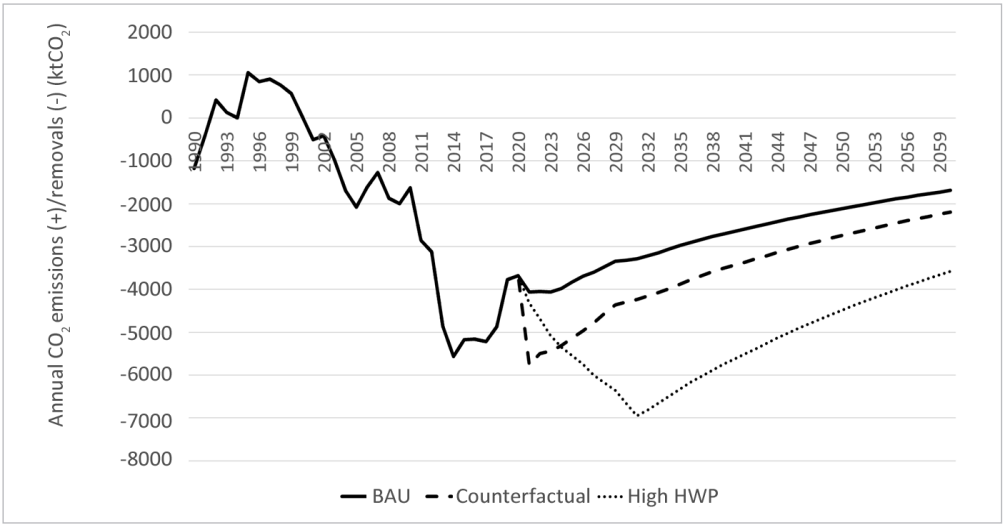

Figure 1.15 Dynamic of annual CO_2 sink in HWP, showing the influence of shift of the same level of industrial production only based on national/domestic wood. By convention positive numbers represent emissions, while negative numbers represent removals from the atmosphere (beware, signs are opposite to the values reporting change in C stocks).

Sourcing roundwood from the domestic forest only to satisfy the national industry at the historical demand level, e.g., no imports and no exports results in some 1MtCO_2 additional sink annually. A sudden ban of the import and/or export would have a significant impact in the initial year, e.g., a benefit of 2MtCO_2, while afterward the effect would stay, but it would diminish to some 0.5MtCO_2 in 2060. The application of the measures with slow onset, like "High HWP" would allow a slightly delayed, but overall, maximization of the HWP sink, from an immediate 4MtCO_2 to some 2 MtCO_2 in 2060, compared to BAU.

Discussion

Given currently missing robust data on harvests in Romania, the interaction of HWP scenarios with forest sink cannot be substantiated. This is in spite of existing methodological experience in running models and validating modelling exercises (e.g., Blujdea 2018; NFAP, 2020; Blujdea 2021). This relates to a long-delayed opportunity to assess the potential competition among wood uses, as well as their impact on the forest sector sink, and its potential contribution on the economy neutrality. Nevertheless, such an endeavor is crucial in supporting Romanian authorities in making forthcoming decisions, i.e., on how to utilize the LULUCF target for 2025 (under "LULUCF regulation") and to negotiate the new LULUCF target for 2030 and 2035, and move toward neutrality in 2050 (see the proposal for the new LULUCF regulation, as part of the Green Deal proposal by the European Commission published on 14th of July 2021 (European Commission, 2021)).

Definitely, increasing the harvest above a certain level would be associated with a decreasing forest sink, while the GHG benefit from HWP would not allow compensating the loss from forest, resulting in an overall negative balance in the accounting. This is related to the overall low efficiency of transformation of standing biomass to utilizable solid biomass because

of many losses, i.e., losses due to un-utilizable belowground part of the tree, losses from the aboveground part (i.e., branches, tops, stumps, and losses associated to conversion of standing tree to transportable log), and log share allocated to firewood.

On the other hand, stopping harvest from domestic forests would result in HWP being a source for all the years when there would be no domestic harvest (i.e., no annual gain, but loss from historical products). According to the calculation supporting this paper, the emissions would be equal to the current sink by HWP (e.g., around 4MtCO_2) in the relevant year. Indeed, that would associate with higher sink in forestland.

In effect, across the national GHG inventories, there are four wood pools: standing living biomass, dead wood, wood products and wood waste. Generally, approximately an order of magnitude defines the amount of carbon hosted by managed natural stocks (i.e., biomass and dead wood) and fully anthropogenic deposits (i.e., products, waste) within national boundaries (Table 1.8). Such a low stock in the anthropogenic deposits would most likely not compensate for the stock loss created by initial disturbances of natural forests, i.e., a historical carbon debt related to wood removals from forests. Ironically, the forest sector needs to start looking for solutions to alleviate this debt. Regarding the net sink associated with each of the four pools, the potential of anthropogenic actions is shown by higher share of sink to stock for the anthropogenic pools.

Table 1.8 The four wood pools in Romania: magnitude of C stocks and net sinks from various references.

Wood pool (and its description)	**C stock (M*tC)**	**Net annual sink** (MtCO_2)**	**References**
Living biomass (natural managed, aboveground only)	675	-16.0 ÷ - 24.0	SOEF (2021), FMRL value as of UNFCCC (2021), FRL as of NFAP (2020)
Deadwood (natural managed, standing and lying)	12***	-0.065	NFI2 (2021); Blujdea et al. (2021)
Wood products (anthropogenic)	50	-4.0	UNFCCC (2021)
Wood waste (anthropogenic)	14.0****	-0.5*****	BIOREG project (2018), EUROSTAT waste statistics (2021)

Legend:

**M stands for million. Ratio of CO_2 to C equals 44/12.*

*** negative value ("-") means CO_2 removals from atmosphere, so the pool is a sink.*

**** corresponding to a dead wood stock of 64Mm^3 estimated by NFI (2018), an average wood density of 0.4 and C content of 0.4 as of IPCC (2006).*

***** wood waste in solid waste disposal sites estimated based on backward-FOD procedure, assuming IPCC's default of 35 years half-life (as of IPCC 2006. Chapter 3: Solid Waste Disposal) and a constant annual input of 0.4MtC per year since 1961.*

******Loss as CH_4 emissions is excluded.*

Our entire calculation is based on international statistics on roundwood removals from forests, so it is explicitly attributing the wood products a "commodity" dimension. Thus, any assumption related to the quality of roundwood as a result of the forest management on the ground is beyond our reach. We cannot say anything on the quality of standing wood at stand level per type of silvicultural intervention, or on the wood industry's efficiency in converting roundwood to long-term products. We can only balance between the assumption of a general overall adequate use of wood in the country, i.e., IRW share to total roundwood removal is about 60% according to NIS, to a worrying case where the IRW share to total felling estimated by NFI (as earlier published on site www.roifn.ro) is much lower, around 25%.

Our HWP scenarios give a sense of the potential impact of the mitigation actions on the HWP sink: for an increased sink the annual input needs to increase. The three scenarios may not be fully comparable as the "High HWP" scenario assumes an increase of the harvest in domestic forests, with the fuelwood amount projected as being rather constant. Such an additional significant demand by "High HWP" may only be supplied from additional roundwood removals from forests. Unfortunately missing accurate data on harvest from forests makes any further analysis futile. Further on, the anthropogenic nature of HWP makes it sensitive to dynamics of the economy, therefore, in order to improve the accuracy of predictions, an integrated modelling approach would be more appropriate (to better define the needs of other sectors of the economy).

In any case, C stock in HWP reservoir is set to increase by 2060, e.g., 50% higher under BAU. With active measures, i.e., under "High HWP", it may double until 2060. However, "High HWP" scenario assumes a projection of a similar share of semi-finite products as during 2009-2020. Such an assumption needs due consideration given the dynamic of economic drivers under changing consumption patterns. In such a context, structural wood for construction seems to be an appealing option. Although the consumers' behavior is difficult to stimulate economically (i.e., would a small reward stimulate the substitution of bricks with wood in a residential building?) or culturally (i.e., has eco-labeling any value for the consumer?). Indeed, it is expected that a type of "High HWP" scenario will represent a strong stimulus under Green Deal applications (e.g., carbon removal certification scheme, fostering wood use in residential construction as an energy efficiency measure), in addition to the current intra-LULUCF implicit stimulus through allowing compensating emissions across land-use accounting categories. "High HWP" has an additional downstream emission reduction component which is not reflected here, namely substitution. Given the strong bioeconomy onset, it is likely that wood-based products with short-term life would prevail given many novel applications, e.g., textiles and plastics replacing. Generally, substituting with wood results in GHG mitigation benefit, i.e., substitution factors range from -0.01 - 0.4 tC/tC for using fuelwood (e.g., Leskinen et al., 2018) to 1.1-2.1tC/1tC for replacing traditional materials with wood in construction (e.g., Jonsson et al., 2021). Recycling scenarios may be expected to have an impact on forestland mostly, e.g., an increasing sink given lower harvest.

Cumulated, a net import of some 1 Mm3 has a negative impact on the national GHG balance when compared to BAU, assuming the production of semi-finite products would stay at the historical level. The impact is an annual amount lost from the national accounting of some 250ktC, which is equivalent to some 1MtCO_2, decreasing in time toward 2060 (see Figure 4). The explanation is related to the particularity of the current policy framework, i.e., the LULUCF regulation excludes both imports and exports of roundwood from national

accounting. The exports are excluded because the wood fate at the consumption point in the importing country is not known (e.g., if it is burnt?), and excludes imports to avoid double accounting across countries. This accounting solution may change in the future if, for example, data became available on the actual end-use of roundwood in the importing countries, with credits given to exporting countries as a measure for a fair commerce. Alternatively, importing countries can get the credits for investing earlier in science and innovation and industrial capacities that produce novel products.

The wood-use versatility would most likely be escalating in a strong competition among the four wood use forms: volume, energy, biomass and carbon credits. If in the past, the volume dimension was dominating (e.g., size and shape of roundwood, or aesthetics), the future seems to favor biomass use (e.g., fiber content, accessibility, easiness of supply) depending on the technological development for new materials currently produced from fossil sources. Traditional thinking prejudges a certain hierarchy/order in the multilaterally wood applications: volume, energy, and biomass (limited to pulp and panels). Novel thinking includes two more wood-use features: non-traditional use of biomass and emission reduction attached to new products. The first two scenarios we discussed here covered mainly volume and energy use, while the third scenario provided for including the third dimension (biomass). Including the fourth feature would require a cost-analysis and information on consumer behavior with regard to wood products and substitution. The fact is that any kind of wood type may enter stronger competition. The competition may not be fully driven by wood quality (e.g., volume and shape, presence of inseparable bark) but by the market demand for alternative uses, as well as the roundwood use efficiency. For example, traditionally, some sortiments of inherently low wood quality justified using it for energy. This would be likely challenged as new applications are expected to require more "biomass" rather than "volume".

On average, over the last 10 years, 54% of industrial roundwood feedstock was used for sawnwood, 43% for panels and 3% for pulp, which is a rather adequate processing of IRW. One obvious trend was noticed, namely phasing out national paper and paperboards production from national roundwood, i.e., according to the FAOSTAT (2020), all of it is produced from imported pulp, from secondary pulp (resulted from wood processing) or from recycled paper. The major remaining wood source, between 4 to 16 Mm^3 to enter competition, is used currently for energy, mostly for heat and power purposes in both industrial and residential contexts.

As such, the harvest level has a tremendous impact on the wood use, especially through the informal harvest. An uncompetitive price or source of roundwood removals influences the fate of wood, i.e., a low cost favors its allocation to products which would otherwise require much lower roundwood quality, such as burning.

The FOD, which we use here for estimating HWP contribution to mitigation, is a simplification of real life, as it assumes one life cycle only with the products discarded at the end of its life. However, FOD also uses one parameter which is generally considered of rather high accuracy, namely the annual amount of semi-finite products, i.e., carbon gain in the HWP. In addition to such a simplified approach, many unknowns surround the actual dynamic of HWP losses, e.g., emissions to atmosphere. In order to capture the Romanian consumer behavior, real data is needed on: a) actual life in use/service for semi-finite products, or even more detailed at the level of end-use products; b) dumping habits, e.g., products out of use but dumped in conditions different than those for which they were designed to serve, c) end of life habits, e.g., burning, recycling or issuing as waste.

Conclusions

The HWP would represent a sink in Romania for the forthcoming 30 years almost irrespective of which scenario is being applied. Nevertheless, economic downturns may have a strong impact on the HWP sink, and it may even turn the HWP into a source. Certainly, an additional HWP sink can be realized through higher harvest from forests, although an additional sink of some 4 $MtCO_2$ in the HWP pool would likely generate a loss of around 10 $MtCO_2$ from living biomass in forestland (assuming current practices in the forestry sector, both forest management and wood processing). Given current accounting rules under LULUCF regulation, while halting the export of roundwood may have a short-term positive impact on HWP sink, halting domestic harvest would have a dramatic impact on the accounting because it would be turning HWP in a long-term source.

Unfortunately, a complete analysis of the Romanian forestry sector contribution to GHG targets is not possible given missing information on harvest from national forests. Further on, a robust estimate of the accountable amount from HWP under immediate policy compliance with the 2025 target is not possible at this moment because of missing comprehensive data on deforestation.

Take-home messages:

- The contribution of wood use to emissions reduction strategies is rather small and heavily influenced by major events in the economy, i.e., a significant drop in wood consumption or sudden change in consumption pattern may convert HWP reservoir into a source. Currently, the annual sink in wood product reservoir represents about 25% of the annual sink of Romania's forest (around 20 $MtCO_2$ per year).
- Missing robust data on harvest, the share between solid and bioenergy use, the historical deforestation rate and harvesting efficiency do not currently allow a realistic assessment of the actual atmospheric impact of the wood products pool.
- Data on Romanian consumer behavior is needed on: a) actual life in use/service for semi-finite products, or even more detailed at the level of end-use products; b) dumping habits, e.g., products out of use but dumped in conditions different than those for which they were designed to serve, c) end of life habits, e.g., burning, recycling or issuing as waste.
- It is expected that the transition to bioeconomy would result in a reshuffling of the demand among the wood uses' three dimensions: volume, biomass and energy content. In addition, the fourth dimension, i.e., wood in emission reduction schemes, would require integrated decision making across wood processing industries, and a competition between traditional and novel uses.

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1.4. Moving Away from a Generalized Stumpage Sales System - a precondition to relaunch the high value-added bio-based solutions and a sustainable circular bioeconomy

1.4 Moving Away from a Generalized Stumpage Sales System

- a precondition to relaunch the high value-added bio-based solutions and a sustainable circular bioeconomy

Radu Vlad

Summary

The way we use the wood prescribes the way we manage our forests[15]**.** If we want to get more out of less (referring here to the volume of harvested wood), it is essential to promote high value-added bio-based solutions (EU Forest Strategy for 2030) – a basic strategic direction that should be clearly reflected by the national forest policies.

Given the sustainability limits of the annual allowable cuts, as well as the local demand for firewood and rural constructions (N.B. a critical aspect in the short-medium term for supporting the local communities' livelihoods), the forestry sector in Romania cannot afford to become an exporter of primary processed timber (Giurgiu 2014). In order to decrease the pressure on forest ecosystems and to meet the socio-economic and environmental development objectives, the forestry sector needs to optimally use wood, by promoting superior wood processing and generating added value in line with the principles of cascading use[16] and the sustainable circular economy.

In this respect, a necessary first step is to start the transition from a generalized stumpage sales system to the assortments sales, aiming to give the appropriate industrial destination for each assortment and, by this, to achieve a superior added value.

In line with the New EU Forest Strategy for 2030, this paradigm shift facilitates access to multiple benefits, from the perspective of (i) increasing the **efficiency of systems to combat illegal logging**, (ii) incentivizing **close to nature forest management practices[17]**, and (iii) promoting long-lived wood-based products that can help to achieve climate neutrality by storing carbon and substituting fossil-based materials.

Introduction

Trapped into an endless transition from communism, the Romanian forest-based sector is still struggling to adapt to the European single market. In the absence of a national forest strategy[18], one of the only few constants of the forestry sector is the stumpage sales system, the main entry point for timber harvested in Romania on the global market. As a multiannual

[15]This has a major role to play in meeting the climate and biodiversity objectives since forest conservation cannot be limited only to strictly protected areas.

[16]Under this principle, wood is used in the following order of priorities: 1) wood-based products, 2) extending their service life, 3) re-use, 4) recycling, 5) bio-energy and 6) disposal (EU Forest Strategy for 2030)

[17]Examples include long rotation, forest landscape mosaic structure, natural regeneration treatments that promote the natural type of forest, periodicity and intensity of forestry operations, tranquility period before starting the regeneration, etc. (NT5).

[18]According to the Recovery and Resilience Plan for Romania, the National Forest Strategy 2020-2030 should be developed by September 2022.

average, about 80% of the wood in Romania is placed on the market as standing wood. It's worth mentioning that there were years when this percentage was even imposed as a mandatory target for state forests to achieve at least 85% (HG 617 /2016). Romania is the only EU member that still promotes this system as a state policy.

This legacy from the communist era, when the stumpage system made sense given the centralized and planned economy at the time, has decisively influenced the direction that forestry has followed over the past 30 years. Given the new socio-economic context, its maintenance and enforcement at the national scale, has generated systemic conflicts of interest. Furthermore, the superior use of wood has experienced an accelerated regression in parallel with the closure of the former superior wood processing plants. Subsequently, these industrial plants were largely taken over by a primary wood processing industry, focused mainly on the export of raw materials.

In a stumpage sales system, operators pay in advance an estimated timber volume of some standing trees, followed by timber grading performed in order to maximize the use of different assortments. The timber grading is, therefore, decided and performed by the operators according to their technical knowledge, contractual constraints, and economic possibilities. But, in a growing economy, coupled with a lack of predictability of forest policies, the possibilities of the local operators are often quite limited, especially when non-competition market practices occur (i.e. infringing the competition rules), and when the market is dominated by the influence of the afore-mentioned primary processing industry. This is why in many situations, converting the wood into distinct/superior assortments is no longer adequately performed for maximizing the use of wood and, as a result, high-quality wood sometimes goes directly into fiber and particle boards or is even turned into firewood. In other words, one can say that we are "casting pearls before swine".

On the other hand, in terms of forest management plans, the Forest Act establishes, through its regulatory framework (NT5), a multifunctional role for commercial forests. Thus, long rotations, often of 120-180 years, are imposed for the commercial forests in order to provide superior wood assortments (i.e. high-quality timber) in addition to their ecological benefits (see chapter 1.2). Unfortunately, too little of this high-quality wood ends up in high added value products following an adequate use of these assortments targeted by the forest management plans. In this way, the effort sustained by the forest management models is not valued at all. The underlying problem is that we neither support the production of such superior assortments nor do we boost the demand for such wood products (also from an economical perspective). Thus, a question arises among forest owners: why should we continue this practice? In this context, we should highlight that a sustainable development of bioeconomy does not simply rely on increasing the amounts of raw materials, but it relies on increasing their quality (N.B. increasing the production of cheap raw material is in fact counterproductive).

Recently, the new EU Forest Strategy for 2030 (see Impulse 3) reinforced the importance of a sustainable forest bioeconomy that relies on sustainable forest management practices and on optimal use of wood in line with the cascading principle and the circular economy approach. This is also encouraging for the emerging national forest policy vision, that it must strive to find the best solutions for promoting these principles (N.B. when forestry business models go hand in hand with forest management models and environmental conservation objectives).

When Stumpage sales become "the norm"

The generalized stumpage sales system is significantly contributing to the existing challenges that the Romanian forestry sector faces at present.

In a super-centralized system (in which various state-owned companies only have distinct responsibilities in terms of forest management, wood harvesting, and wood industrialization), the stumpage sales system was somehow a matter-of-course. But, even when state harvesting enterprises and wood industrial plants were taken over by private companies, the stumpage sales system still prevails. The reasons for this are manifold: → the high share of small local operators having a low investment capacity; → significant changes of the forest ownership, conveyed in many fragmented properties governed by small and low-intensity forest management; → the lack of investments in forestry infrastructure (e.g. forest roads, landing areas, yards), amplified by the administrative framework that followed the chaotic restitution process (e.g. the forests and the forestry infrastructure are not managed by the same owner/administrator), etc. The list can go on, but perhaps the most important reason was the unpredictability caused by the lack of a coherent vision in terms of adapting the national forest policies to the new socio-economic context. A relevant example in this regard would be the wood selling regulation that was successively amended 5 times in 3 years, with often diametrically opposed provisions. While the Forestry Code (2015) imposed a robust set of principles for the wood selling regulation, through the subsequent legislation (HG 617 /2016), its scope was diverted and a compulsory threshold for the wood volumes to be sold as standing wood was imposed again at minimum 85% of the total annual allowable cuts.

After more than 80 years of implementation, the current stumpage sales can be seen as a dominant socio-technical system that incorporates not only norms but is reflected in the habits and the very culture of the timber trade. No wonder there is so much opposition to change.

When the Stumpage sales system becomes the "norm" it undermines the efficiency of the system of combating illegal logging, in the absence of proper monitoring tools.

The system for combating illegal logging begins with and is very much influenced by the way the wood is being sold. For decades, forestry in Romania has been selling timber based on a roughly estimated volume of standing trees without being concerned (i.e. no control required) with the quantities taken away from the forest. There are several mathematical models for calculating the standing volume, all of them being legally accepted. This can result in volume differences exceeding 20% for the same inventory of diameters and heights (N.B. without including here the measurement errors or the subjectivity of the operator). The irony is that the contracts on the volumes for the standing wood are based on these estimates given with two decimals.

This goes hand in hand with the control system, whose foundation is represented by the tree marking procedure, which mainly consists of hammering a seal on the stump of the tree. Legally, this stamp does not stand as solid evidence in a court and the whole procedure cannot guarantee anything related to the volume of harvested trees. The same number of marked stumps can represent a different volume and quality of the standing wood (WWF Romania, 2019).

Therefore, in the last 30 years, the advance payments for an estimated wood quantity and quality have been accepted (or even imposed), although the harvested quantities shipped out from the forest are not verified. And this is the applicable legislation. This is why we consider that "a grey zone" has been enforced, one that cannot be controlled. Nowadays, even an electronic wood traceability system such as SUMAL 2.0[19] still cannot efficiently address the most frequent modus operandi (i.e. overloading or multiple transports using the same delivery documents) (WWF Romania, 2021).

A radical change is necessary. Simplicity, transparency, and efficiency are possible for combating illegal logging if we focus on monitoring and implementing a control system when first placing the timber on the market (WWF Romania, 2019).

For this to happen, it would be useful to adapt the electronic wood traceability system (SUMAL), and to facilitate transparent monitoring and real-time verification on wood transports by integrating a new innovative IT & AI solution - the "digital footprint" of the wood transports (i.e. the electronic seal - "electronic passport" of the wood transports in connection to the volumes declared by the transport /delivery documents). Such transparent traceability tools that avoid the subjectivity of the operator, doubled by control plans that follow a risk approach and complemented by a system of dissuasive and proportionate penalties, constitute the prerequisites for an efficient system to combat illegal logging (WWF Romania 2019)

The widespread implementation of the stumpage sales system in Romania represents a significant obstacle to the superior use of wood resources.

By using the stumpage sales system, wood becomes the property of the operators, and its conversion into wood assortments for maximizing the use of timber thereby becomes optional. Therefore, grading timber, to select the superior converted wood assortments is not in the hands of the forest administrations who manage predictable wood volumes on the market, but it is a matter of technical capacity and economic possibilities (including the opportunities/limitations based on their location within the local industry) of each small operator. Most operators are micro-undertakings[20] (having a harvesting capacity of about 2500-5000 m^3/year) and for many of them, converting wood into superior assortments is unrealistic, when it comes to something beyond sawnwood and firewood, from either an economic or a logistic perspective.

Considering the costs of handling, storing, and transporting relatively small volumes of high-quality assortments, selling the entire wood quantity for firewood or sawn timber becomes more attractive for micro-undertakings, primarily because of the absence of further administrative burdens and better cash flow (especially considering the rising of energy prices). In addition, also for the big operators, the demanding contracts imposed by big primary processors (e.g. the bonus systems depending on the quantities delivered) have the effect that the pre-sorting no longer takes place, because it is not needed for such business models. Hence, high-quality wood ends up as firewood or into products with low added value and often into short-lived circular materials (Figure 1.16).

[19]SUMAL - Integrated wood traceability information system established by Government Decision 497 /2021
[20]See DIRECTIVE 2013/34/EU.

Figure 1.16 Without a proper timber sorting, the added value that could be obtained through superior processing, will be lost. © *Vlad Radu (WWF Romania), Ștefan Balea*

Therefore, the stumpage sales system facilitates business models that rely on the use of increasing volumes of wood for primary processing, and thereby leads to less added value, and a disruption of the cascading use of wood. Along with exporting raw materials, jobs are exported as well, deepening the impact on the socio-economic environment and thus feeding the spiral of problems.

How can we make "more from less"?

We can reduce the pressure on forests while at the same time maximizing the socio-economic benefits gained from wood (as a naturally renewable resource), by promoting high value-added bio-based solutions and a sustainable circular bioeconomy. In this last section, I will argue that all these claims can only be supported by a transition from generalized stumpage sales to distinct converted wood assortments sales.

Proposals for immediate solutions:

- A new national forest policy is required in order to support, through an integrated approach, responsible forest management based on "close to nature" principles (see chapter 1.2) along with the optimization of the use of wood according to the cascading principle and sustainable circular economy (EU Forest Strategy for 2030).
- Promoting the vertical integration of value chains through forest consortia that include high value-added wood products, via market incentives mechanisms. In this respect, the managers of public forests should be able to set up additional criteria for assigning timber in public auctions, other than the price only. One such criterion that could be considered is the local socio-economic contribution of wood processing activity in relation to the amount of wood consumed. For the state forests, the government is mostly entitled to decide on the award criteria because it has the

capacity and also the liability to measure the benefits obtained by processing wood "downstream of the forest" and not just the price obtained by the immediate sale of standing wood. The "alchemy" of transforming the wood into "green gold" resides in the added value obtained through its superior processing – and this value is directly proportional to the total taxes paid (e.g. social contributions of employees, corporate, local or environmental taxes, etc.) directly related to the amount of wood consumed. Sustainable management of a natural resource can be attained only if local communities benefit from this resource. Only if local communities understand the need and feel the benefits related to the processing of that resource, they can provide/support long-term solutions. The adoption of these award criteria would also have multiple benefits, directly related to combating undeclared work, tax evasion, illegal logging or, depending on the case, the tax avoidance practices that directly affect the functioning of the internal market. It should be noted that Romania has not invoked, in any normative act, the EU Directive 1164/2016 which highlights the need for ensuring that tax is being paid where profits and value are generated. And yes, conservation without resources becomes more just a dialogue that polarizes society - something that Romanian forestry has experienced already for several decades.

- Public policies for the procurement of timber products should also consider the climate benefits through a material substitution effect and the carbon removal estimated period (see also chapter 1.3).
- The transition to this system cannot be achieved only through constrictive/coercive measures (taking into account the decapitalization of the forest management sector). Additional measures are needed to incentivize the superior use of wood and cascading principles.
- Support through budgetary funds/European funds should boost the development of environmental friendly forest infrastructure (including landing areas and wood depots) and investments into specific logistics.
- The system for monitoring and combating illegal logging should focus on the first placing on the market (EUTR).
- Strengthened sustainability criteria for bioenergy, to minimize the use of wood for energy production and its impact on the social and environmental component.
- Investment in research and innovation (Nichiforel et al 2019) to develop new high value-added bio-based solutions.

Take-home messages:

- The generalized stumpage sales system maintained for decades by the legislation framework is one of the root causes undermining not only the high value-added bio-based solutions upon which the sustainable circular bioeconomy is rooted in, but also the existing close to nature forest management practices established for decades for productive forests in Romania.
- Shifting from stumpage sales system to wood assortments should be a basic strategic direction for the forestry sector in Romania, given the multiple and

significant implications in promoting responsible forest management:

- ensure fair access to the raw material market for high value-added bio-based solutions, thus generating incomes and enabling a sustainable development of local communities-establish the first link of the wood chain of custody and thereby take a decisive step in optimizing the use of wood in accordance with the cascading principle and sustainable circular bioeconomy. This will also enable the best use of long-lived products that will ultimately allow us to build a sustainable and climate-neutral economy (in line with the EU Forest Strategy for 2030)

- value the efforts of forest administrators for implementing close to nature forest management practices through which superior assortments of wood with low environmental impact are achieved following the continuity principles.

- simplify and make the monitoring of timber traceability more efficient, more transparent, and thereby facilitate the implementation of robust due diligence systems (DDS) for combating illegal logging.

- In order to reach these goals, the highly regulatory framework based mostly on command and control, is not enough and, in its current form, it is clearly not sustainable (Nichiforel et al 2019). It is "a must" to have an integrated approach combining regulatory, financial and voluntary mechanisms.
- A clear transposition of these goals into the forthcoming national forestry policy is needed. This can be achieved through a broad consensus among the relevant stakeholders regarding the practical solutions required, and hopefully result in a clear roadmap outlining the forestry sector's contribution to achieve the sustainable development of local, national and European natural forests that communities are dependent upon.

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1.5 The Role of Forest Ecosystem Services for the Forest-based Bioeconomy in Romania

Bogdan Popa

Introduction

Ecosystem services (ES) are defined as all the benefits people obtain from ecosystems, an entire spectrum of goods and services derived from nature. ES in general, and forest ES in particular, are extremely diverse, including tangible products (categorized as provisioning services), regulating services (e.g. carbon sequestration or soil and water regulation that contribute to social wellbeing), supporting services (e.g. biodiversity) and cultural services (e.g. tourism and educational use) (MA 2005). In essence, the concept includes the identification, description, and evaluation of ES in order to support society to make more informed policy and management decisions (Westman 1977).

The bioeconomy concept encompasses resources derived from living biomass as alternatives to fossil fuels, with technology, innovation and research being the key enablers (D'Amato et al. 2020a). Whereas the role of biomass – a provisioning service of forest ecosystems – is obvious in the basic understanding of bioeconomy, the role of other ESs – regulatory, support and cultural – has not been clearly addressed so far in bioeconomy discussions.

There is a huge variety of societal demands on forests, which correlate to various economic activities. There are studies arguing that bioeconomy may jeopardize the fulfilment of some of the societal demands, by affecting the ES flows. For instance, it has been argued that an increased forest biomass entering the economy may affect biodiversity (EFI 2017) and the forests' capacity to mitigate climate change (EFI 2017). Some studies have identified a substantial potential for conflict between the growing demands for forest biomass and for forest amenity values (EFI 2017). However, the broad consensus among scientists (D'Amato et al. 2020b) is that other ES are just as important as biomass production, especially when considering different national and regional contexts. By broadening the definition of the forest-based bioeconomy (FBB) to include economic activities related to all forest ecosystem services, ranging from forest biomass to tourism, recreation and non-wood products, a door is opened for informed policy measures that support the development of economic activities and innovations related to the entire spectrum of forest ES (EFI 2017).

It is, therefore, the country and regional level where efforts should be made to find answers to important questions such as:

- How will the development of FBB affect the flow of ES?
- What is the role of multiple forest ES in FBB?
- What are the regional challenges and opportunities faced by the flow of ES while adopting FBB?

Although the concept of ES has been well-known by researchers, planners and forest managers in the context of the forest management (FM) planning process for a long time, (Nichiforel et al. 2021), FBB remains a theoretical concept for the Romanian forest sector. Many foresters do not yet have a clear understanding of how FBB differs from the current management practices that consider differentiating between ES categories, but rely mainly on biomass production to gain financial benefits. It is, therefore, worth discussing how the

Romanian forest sector can approach these two concepts (FBB and ES) and identify beneficial synergies between them. After identifying and discussing the main opportunities and challenges faced by the Romanian forest sector when transitioning towards a FBB, this chapter will make some recommendations on priority actions.

The Romanian FBB perspective

In Romania, society has become more and more interested in forests and, particularly, in some of the forest ES such as biodiversity, carbon sequestration, recreation and effects on human health (Popa and Pache 2016). On the other hand, the implementation of FBB will increase the demand for forest products and services having a direct economic value – especially biomass – which means increased opportunities for the forest-based sector. Reconciling these multiple demands — i.e., biodiversity conservation, carbon sequestration, recreation with intensified biomass production — remains the most challenging task for FBB. To better understand these challenges, we first need to highlight a series of well-known contextual features that quantitatively and qualitatively influence the demand and supply of the Romanian forest ES. These features set the Romanian forest-based sector apart from its European counterparts.

- The approach to ES provision is mainly regulatory and is based on the technical requirements used in the FM planning process. Since 1954, the multi-functionality principle in FM planning is assured by the definition of functional categories (i.e. ES). Forest ES are identified and mapped at the stand level during the mandatory FM planning process, and the assigned functional category influences the type of management practice. Thus, management planning procedures have considered a large set of forest ES long before the implementation of modern approaches to ES categorization. The functional categories currently in use in the management planning process cover almost the entire spectrum of forest ES (Nichiforel et al. 2021).
- The forest resources in Romania are in very good biophysical condition. Besides favorable ecological conditions, the long period of sustainable FM practices, set in the framework of FM plans, resulted in high-quality forests on large surfaces, with a high growing stock (IFN 2018), and high levels of biodiversity (Knorn et al. 2012). The implementation of the multi-functionality principle in management planning resulted not only in securing the provision of forest ES, from the perspective of the sustained-yield principle, but also from the view of distinct measures assigned to regulatory functions, recreational values and biological diversity. Naturally regenerated forests are predominant and there are large areas of old-growth forests. These features of Romanian forests determine the provision of rich flows of ES and, consequently, a large spectrum of forest resource use options.
- A large share of Romanian citizens (44%) are living in rural areas. Most rural households traditionally use, to a large extent, the products and services of the forest for their livelihoods, based on long traditions of using sustainable forest resources. The Romanian rural environment is rather harsh; the unemployment rate in the rural areas is high and, in some cases, access to education is limited. Therefore, there is a clear tendency of the population to leave villages for urban areas or to emigrate. The urbanization trend is strong, and the urban population has a different relationship with the forest, having different perceptions and demands regarding the services

offered by the forest ecosystems. Thus, rural and urban Romanians hold different views regarding the demand for forest products and services.

- Romania's transport infrastructure is still underdeveloped, leaving areas with significant potential for forest ES disconnected, thereby greatly limiting the economic potential of some forest resources. Regarding the industrial infrastructure, the wood harvesting industry, dominated by small and medium enterprises (Nunvailer et al. 2020), relies on an obsolete, only partly mechanized skidding technology, and has very limited access to technology and innovation (Moskarlik et al. 2017). Investments in the wood processing industry for over a decade have resulted in an increase in production capacity coupled with increased productivity growth (Țucunel 2018). This created a certain potential for innovation and access to modern technologies.
- Romanian society is not made aware of any cost-benefit analyses of forest ES since their provision is largely mandatory. The forest ES evaluation attempts are rather shy and, despite the existence of a private forestland owner's compensation system, the payments for ES mechanisms are still an issue (Dragoi and Cîrnu 2016) given the high level of restrictions (Nichiforel et al. 2018). This may explain why payments for ES were a clear strategic option raised by forest sector stakeholders during the consultation process in 2021 (Popa et al. 2021).
- The legal framework is unreformed and therefore hard to enforce and is considered to be very prescriptive (Popa et al. 2021). It is viewed as a barrier to wide-ranging market development. The public institutional setting (e.g. relating to forest property rights) and its political culture (e.g. relating to the implementation of EU policies) still need improvement. Despite a clear agreement among sectoral stakeholders about certain strategic directions (Popa et al. 2021), for many years, there is no development strategy or documents of public policies regarding the forest sector in Romania.

Therefore, the Romanian forest-based sector is facing both challenges and opportunities. FBB however, may provide interesting approaches to transform the above-mentioned weaknesses into opportunities.

Provisioning services: forest biomass resource, efficiency and the development of the supply chain

Both biomass and provisioning services are at the core of the FBB. Despite concerns related to resource exploitation, there is enough biomass in the country to sustain the needs of a sustainable FBB in Romania.

Data from the Romanian National Forest Inventory (NFI) suggest that wood removals at the country level represent around 65% of the annual total increment. Despite the potential limitations of the NFI data, these figures indicate a large forest biomass potential and consequently, ample options for forest biomass use. Furthermore, half of the harvest is used as firewood in rural areas, sometimes regardless of the quality of the wood (Popa et al. 2020). This situation can be interpreted as good news from a biomass availability perspective, given that the rural population is expected to decrease in the future, followed by a reduction in firewood consumption (ME 2018). This may favor a higher supply of wood for other higher-value applications, including biomass for energy burned in facilities far bigger and more efficient than those used by rural households. Coupled with the fact that biomass is accumulating in the

Romanian forests, and assuming that the export of firewood will not increase significantly, this indicates that the threat of using higher biomass quantities for energy is not as high as in other countries in Europe.

One market advantage that should also be underlined is that production goals are set for long rotation forest systems, thus resulting in high-quality timber that can be used for furniture and constructions, which is also consistent with the CC mitigation strategies. Coupled with the high share of broadleaves, Romania can be an important market player for some specific timber products (e.g. veneer, furniture, barrels). Unfortunately, it is often the case that high-quality timber is used for firewood in locations where the demand/price is high or because of the standing trees rotting (as it is the case of beech).

The Romanian forest-based industrial sector has short, classical value-added chains. Excepting some big industrial facilities producing highly processed wood products and furniture, the end of the supply chain is represented by small companies, mainly with domestic capital and rather modest economic performance, which uses classical technologies, and activates in a very prescriptive and regulatory environment with limited access to credits and EU programs for innovation and technology. So, there is a dire need for technological development and investments. Driven by FBB business models, these investments can lead to an improved value chain for biomass products supply and increased resource efficiency.

Support ES: Is biodiversity threatened by FBB in Romania?

The discussion about supporting ES (particularly biodiversity) is closely related to the above-mentioned biomass resource. The recently elaborated EU's biodiversity strategy for 2030 (EC 2020) promotes more than ever the need to enhance the quality, quantity and resilience of the forest. The high levels of forest biodiversity (Knorn et al. 2012) along with big, old growth forest areas (Munteanu et al. 2019) put Romania, despite the envisaged pressure of FBB on biodiversity (EF, 2017), in an advantageous position to find optimal solutions for the continuous provision of regulation ES, especially biodiversity. However, there are two issues worth discussing, in addition to the more technical ones provided by experts in the field:

- The issue of integration, at the level of forest ecosystems, of support ESs (including biodiversity conservation) and provisioning ones (especially biomass supply). The forestry practice in Romania, along with other factors, has favored very high levels of biodiversity in the country, while maintaining a biomass flow that meets the needs of society. That is why some forest stakeholders (Popa et al. 2021) believe that a segregationist approach (i.e. territorial separation of production and protection forests) is not the solution for Romania. This remains the case if coercive instruments (predominant in the current legislation but less desirable in the future) or incentives allow maintaining the current FM system, based on the principle of integrated and continuous supply of the entire range of ESs. This is another opportunity, from an FBB perspective, not to segregate the supplying surfaces based on the type of the main ES provided. Along with other countries like France, Germany, or Switzerland, Romania has proven that biodiversity conservation and active FM are perfectly compatible.
- Another important, and perhaps less understood aspect is related to the private and public decision makers' interests in biodiversity: the FBB will increase this interest in Romania. Biodiversity conservation means investment needs in institutional

and legislative infrastructure. It also means financial incentives for compensatory payments and research funds. Without biodiversity, we have no ecosystems and without ecosystems, we have no biomass resources. Bioeconomy – an economy based on nature and the sustainable use of natural resources – is a huge opportunity to place nature and biodiversity at the heart of the economy. Biodiversity is what determines resilience – the ability of ecosystems and biological resources to adapt and evolve in a changing environment (Oliver et al. 2015). Therefore, investing in biodiversity should be a precondition for a sustainable bioeconomy. Without biodiversity, there is no bioeconomy. At the same time, a profitable and long-term bioeconomy can provide the necessary incentives for forest owners, forestry companies, and processing industries, to invest back in nature to strengthen biodiversity. Romania's forests can meet both the needs of bioeconomy and ambitious biodiversity conservation objectives. To achieve these, however, the forest-based sector must be involved in finding and implementing consensual solutions instead of being seen as part of the problem. Any unidirectional approach, which excludes the experience and infrastructure of the forest-based sector, is deemed to fail, especially since private ownership of forest land in Romania represents 36% (with almost 1,000,000 forest owners). Wood is used by 4,4 million families in rural areas and the forest sector and associated wood processing industry represent up to 5% of the GDP, being the second most important employer in rural areas after agriculture.

Regulation services – FBB and climate change mitigation

Many regulation services are provisioned by the Romanian FM planning process: water protection, soil protection, protection against pollution, and harmful climatic factors. All together these services are provided for more than 40% of the Romanian forests in mandatory conditions and with very few compensating mechanisms in place.

The scientific literature recommends several climate change mitigation strategies (EFI 2017): conservation management, sequestration management, increasing carbon storage in wood products, and substitution management (see also chapter 1.3). Mainly due to the forest's biophysical condition, but also due to the present economic and energetic context, FBB can place Romania in an advantageous position in implementing these strategies.

In terms of **conservation management**, the forest area in Romania is increasing, with large areas of natural forests (IFN 2018) resulting from a long period of low interventions but still active management. There might be some incompatibilities between the increased economic incentives for biomass utilization and forest conservation, but the long-term implementation of sustainable FM is a clear premise for very low forest degradation.

Regarding **carbon sequestration management**, harvest rates have been significantly lower than increments, leading to carbon accumulation in biomass and forest soil (IFN 2018). However, carbon sequestration is likely to decrease because the Romanian FM system is encouraging mature natural stands and large carbon stocks in the ecosystem, while management continues with reduced intensity, resulting in prolonged rotation length, and increasing average age in the managed forest. Considering that younger stands generally favor carbon accumulation (EFI 2017), even a small change – in terms of a more active FM with increased biomass quantities feeding the specific supply chain –

can be an opportunity for the FBB and carbon sequestration management in Romania.

Increasing carbon storage in wooden products is also an important opportunity. For a long period, Romania has been a net exporter of roundwood, but this situation has changed in the last decades when increasing volumes of higher added value products have been exported. The forest-based sector and its associated wood processing industry have a positive external commercial balance due to the present predominance of value-added products in exports, with more than 1,2 billion EUR represented by wooden furniture – a long usage wood products category, according to official reports of Romanian Furniture Producers Association (APMR 2019). This indicates a significant increase in the length of the supply chain and the added value while Romania is a net importer of roundwood in the last decade. However, this tendency needs to be supported with measures targeting a more efficient use of the resource, especially of wood for heating and cooking in rural areas.

In terms of **substitution management**, we have already explained why, under present conditions, the pressure on biomass for energy is not expected to be very significant. Therefore, biomass for energy can be an important substitute for fossil fuels in Romania in an enabling institutional, regulatory, and investment environment.

Cultural ecosystem services – forests, rural local communities, ecotourism and beyond ecotourism

The cultural ES are addressed to a smaller extent by the FM planning process, which mainly considers forests with urban and touristic recreational functions, forests aimed to preserve the natural landscapes and natural heritage forests. Forest certification provides examples of the identification of cultural ES based on participatory approaches (Scriban and Nichiforel 2021) indicating the potential to make use of the full range of ES for bioeconomy markets (e.g. forest used for traditional festivals, forest near cultural heritage places, etc.).

As already mentioned, Romania's rural population is much higher, in terms of percentages, than in other EU states, but there is also a growing urbanization process. In the last 30 years, many rural inhabitants have migrated to urban centers adopting a new way of life. This has led to changing perceptions and needs related to forest ES. As a result, urbanites mainly associate forests with recreation services. Together with certain global trends and faster-circulating information, this has led to an increased demand for cultural ES, especially for nature-based tourism. FBB, by encouraging economies to build upon the entire spectrum of ecosystem services (EFI 2017), will also encourage the demand for this category of ES. For Romania, the increase in this demand – given that ecological tourism, with all that it means, is still in its infancy – is beneficial because it will support the development of an eco-touristic infrastructure and the emergence of new skills especially among the inhabitants of amenity valuable remote areas, resulting in decent jobs and consequently a better inclusion.

Romanian forests have limited accessibility and are often distributed in geographically isolated areas. Therefore, mobilization, transport and processing of forest resources (especially biomass) tend to be more expensive and complex compared to other resources because it requires investments in transportation and processing infrastructure. With wise policies in place, this apparent economic disadvantage of FBB can be transformed, in the case of Romania,

into inclusive prosperity by distributing welfare, jobs and infrastructure in larger areas of the territory, including isolated rural areas.

The FBB may potentially provide the necessary green infrastructure (social, transport, people, institutions, services) which will create the opportunities needed for stopping the rural population exodus in Romania. Thus, FBB can be an essential solution for inclusive prosperity by multiplying the local community benefits of forest ES.

Summary

For a sustainable, and inclusive FBB transition, regional differences in Europe must be taken into account. Instead of threatening the flow of ES, the FBB can become an active enabler. With a proper approach, it can even optimize the actual use of ES. Starting with a large, quality forest resource, the FBB can turn many significant socio-economic issues into valuable opportunities (i.e., efficient and effective forest resource use, value chain development, investments in biodiversity conservation, climate change mitigation, and rural development). The biggest challenge is to find ways for the FBB transition to successfully continue to adopt good practices (i.e., integration of forest functionality, solid ES-based FM planning process, long rotation cycles) while also taking into account all the necessary and enabling measures described above.

Take-home messages:

- In Romania, the provision of multiple forest ecosystem services is regulated for decades by the mandatory FM planning which uses a functionally-integrated approach;
- There are premises showing that Romania's biomass resource is sufficient to meet the FBB development needs;
- The long-term implementation of FM plans show that the continuity and even the increase in supplying biomass do not pressure the quality of ecosystems nor their capacity to provide other ES categories;
- Regulation ES (especially for water and soil) are mandatory and integrated into the management planning procedure, and provided for free at the opportunity costs of forest owners;
- FBB in Romania has real chances to increase the forests' role in mitigating climate change by applying the concept of climate-smart forestry;
- Given the socio-economic particularities of the Romanian rural environment, the increased interest in the forest resource will amplify the direct and indirect benefits provided by forest ecosystems. This will lead to both the development of infrastructure and the creation of decent working conditions for rural communities, making the option to stay/return home viable.

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EXPERT INSIGHTS: Can Biodiversity Conservation and Forest Management Be Reconciled?

Costel Nicolae Bucur

The decline of biodiversity is obvious at a global scale. Also, there are obvious links between the fast-decreasing biodiversity and the exploitation of natural resources[21].

As the global population is growing, so are the needs for food, land, housing, and energy. Unfortunately, the relationship between these phenomena is not linear[22]. Not only the basic needs of the 21st century must be satisfied, but greed or overconsumption contribute to a great extent to the imbalance of the demand and supply ratio. In these circumstances, proving the real existence of sustainability, beyond a mere theoretical concept, becomes a challenge.

In the case of Romania, modern biodiversity conservation efforts have started rather late in comparison to other developed states (see section 1.2). Nevertheless, standalone endeavors and robust biodiversity concepts behind forestry and hunting activities date back to the 20th century. One such example: Romania's large carnivore populations, and the area of pristine forests which both ensure healthy habitats, remain the largest natural environments in the EU. Despite these treasures, the public discourse in recent years has scrutinized forestry practices as "unsustainable", or even blamed these practices for contributing to biodiversity and forest area loss.

Romanian forestry adopts an integrated approach, targeting multiple ecosystem services and enhanced wood production (both in terms of quantity and quality). This approach was relatively easy to implement in the state-owned forest, but ownership diversification raised many expectations from forest owners. From a formal perspective, the principles governing Romanian forestry are equally applicable irrespective of ownership type: they are assessed as highly effective for biodiversity, expensive to implement, and yielding low economic efficiency. But the political influence and the acceptance of inappropriate working conditions among foresters (caused by poor governance, unclear and thus interpretable rules, expanded bureaucracy, and lack of clear liability) have led to a series of abuses during the late 1990s and the early 2000s. All these factors have triggered harsh criticism from the broader public. Although on the positive side, such criticism certainly succeeded in raising awareness of

[21]https://ec.europa.eu/commission/presscorner/detail/en/MEMO_04_27

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the importance of forests and forestry in Romania, this was not always constructive in the sense that debates became very heated. Instead of opening up the possibility of constructive dialogue between forest managers, forest owners, and the broader public, the heated debates only managed to further polarize opinion. Different expectations regarding issues such as production and the protection of forests became harder to fulfill. Concerned actors, i.e., private owners, institutions, and authorities, did not manage to create an unbiased, transparent, and fully participative process, and to alleviate conflicts by providing scientific, truly independent support, enhanced communication, and transparency.

Yet, the sustainable use of forest resources is integral to Romania's history and development. This is effectively proved by forest indicators (see section1.1). Thus, forest managers, in particular, have gained important experience over the years. But this experience must be coupled with innovative approaches to managing our forests and to making the best use of harvested wood. This is particularly relevant in the context of climate change. For example, removing CO_2 from the atmosphere and storing carbon in land C pools and wood-based products remain attractive pathways that can enable the national economy to become climate neutral (see section1.3). Sustainable silviculture plays a critical role here. Wood is a great material resource that continuously surprises us with its wide range of uses and environmental benefits. New wood processing technologies show an unlimited potential for producing wood-based products. The renewable attribute of timber should not, however, override our responsibility to ensure sustainable yield and ecosystem services.

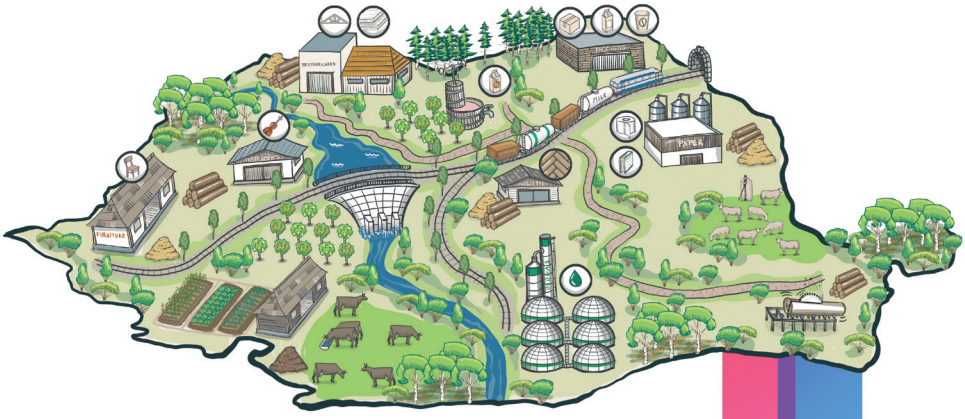
Apart from wood, forests are communities of living organisms that are constantly producing a wide range of products and services. Understanding the processes governing the forests and following the natural evolution of their elements and interactions ensures that one obtains the most benefits from managing them. In these conditions, benefiting from these amazing ecosystems is a great opportunity and responsibility, which must be further understood and considered by the Romanian forestry sector.

The major concern of some environmental organizations is that harvesting leads to biodiversity loss. Whereas this issue may serve activism purposes well, it is misleading for the wider public. The critical question faced by active forest management is less "if" or "what", but "how" can multiple forest management objectives be reached. In this respect, Romania could be a good example.

Reconciliation is possible, and it has to start from an analysis of the facts (e.g. a close to nature silviculture, local species, long rotations, shade treatments, a diverse forest landscape, harvesting level well below the current growth, compulsory forest management planning, and administration, etc.) which best reflect the current situation. Moreover, trees, forests and the forestry sector should work better at integrating economic, greenhouse gas mitigation, and conservation with other land uses like croplands and grasslands at the landscape scale, and at both regional and local levels. The existing regulatory framework is already very environmentally friendly and properly addresses various concerns of biodiversity conservation practitioners. However, some elements of enforcement and implementation could be improved. Finally, more engagement from stakeholders would be an enormous add-on, especially if we continuously improve our communication and work on building trust.

Take-home messages:

- Romanian forestry holds a conservation-oriented and close to nature silvicultural system that proved its effectiveness for wood production and forest conservation across the decades, satisfying economic, social and environmental demands;
- Significant costs associated with such a management system are borne by the forest owners and most of the restrictions imposed by national obligations are not compensated;
- Bioeconomy has a strong and sustainable base in Romania, with resilient forest ecosystems, based on a diverse resource, i.e. a wide range of tree species, both broadleaved and coniferous.



INNOVATION

TRADE

BUSINESS

PART 2

IMPULSE 2: Investing in Knowledge, Research and Development

Doru-Leonard Irimie

While forestry is not a 'distinct' EU policy area as per the Treaty of the Functioning of the European Union, it is nevertheless falling under the scope of a number of key EU policy areas, such as rural development, environment, biodiversity, energy, climate change, plant health, trade or research and innovation. Consequently, it can be said that forest-related legal action is primarily and increasingly taken in policy areas other than the forest area (Winkel et al. 2013).

Historically, support for research and innovation in the co-decision procedure is relatively high, and it is expected to remain so, for the near future. Thus, the EU-funded forestry research increased in line with the increasing share of the EU's Framework Programme for Research and Innovation in the EU budget, from one Multiannual Financial Framework to another, in particular from FP7 (2007-2013) to Horizon 2020 (2014-2020) and is projected to increase further under the recently adopted Horizon Europe (2021-2027). Thus, a simple search using the keyword 'forestry' in the official database CORDIS (May 2021) reveals more than 3,000 projects, half of which are FP7 and Horizon 2020 projects. In terms of the breadth of the topics, they are covering virtually all areas throughout the value chain from primary production to wood-based applications in the bioeconomy and their uptake by the society, and are coming from both 'top-down' ('programmed') chapters, in particular the Bioeconomy part, and 'bottom-up' programmes such as Marie Sklodowska-Curie Actions.

A general trend observed from examining Framework Programme projects is the increasing scope and partnership (and consequently budget) of the projects and the gradual move of focus toward the upper end of Technology Readiness Level, i.e. from basic/applied research to innovation and development. Nevertheless, very popular research themes such as: the assessment of ecosystem services, forest genetics, multifunctional forest management, combating pests and diseases, forest fires management or wood-based products (novel and traditional alike) appear in many Framework Programme projects.

An important indicator of the impact of projects funded through the EU's Framework Programme for Research and Innovation is their added value compared to those developed/funded at a national level. Mid-term and final-term evaluations of the Framework Programme often put forward the well-above-average quality of these projects, the economies of scale and the reduction of fragmentation and duplication. More specifically, the interim evaluation of Horizon 2020 (European Commission 2017), taking stock of independent studies, mentions that more than 80% of the grants are funding very distinctive projects, which would have not occurred in the absence of EU funding.

These developments, in particular those seen in the last two Framework Programmes, followed closely the developments mentioned in two key and interrelated policy documents: the EU's Bioeconomy Strategy (adopted 2012, revised 2018) and the New EU Forest Strategy (adopted 2013, revised 2021). Thus, the Roadmap 'EU Forest Strategy 2020 (European Commission 2020)' emphasizes the need for "a strong research and innovation agenda to improve our knowledge of forests and to optimize their composition, structure management and use, including for the bioeconomy".

Even so, the EU funding to forest research and innovation represents only a minor part of the national funding dedicated to research, which has a share in the EU's GDP of around 2.5% as of 2020. Expectedly, there is a direct relation between the share of research funding within the GDP of a member state and its overall success in participation in projects funded through the Framework Programme. To enhance the performance of low-performing member states, mostly the 'EU-13' (new member states, acceded from 2004 onward), since Horizon 2020, the 'Spreading Excellence and Widening Participation' chapter has been introduced which aims to "to reduce disparities and the existing divide in R&I performance by sharing knowledge and expertise across the Union" (European Union 2021). Notwithstanding, the success rate among the target member states is uneven, and so is the focus on research areas of projects resulting from the 'Widening' calls. Thus, Romania is still to obtain funding for a project in a forestry-related area under these calls.

The uneven development of forest-based bioeconomy in Europe is discussed in a number of studies, for example, Lovrić M. et al (2020) reveal a high centralization of the relevant research to a few countries and organizations from North-Western Europe, while Eastern Europe remains inadequately integrated into the European research network.

Nevertheless, some academic partners based in Romania are or have been involved in projects developed under different calls for proposals, such as the Faculty of Silviculture and Forest Engineering (Transilvania University of Brasov) (HoliSoils), Forestry Faculty (Stefan cel Mare University of Suceava) (FunDivEUROPE) and National Institute for Research and Development in Forestry "Marin Drăcea"(DIABOLO) .

Another notable initiative developed to tackle the untapped potential of the bioeconomy in the region is BIOEAST – "Central-Eastern European Initiative for Knowledge-based Agriculture, Aquaculture and Forestry in the Bioeconomy. This is a joint initiative of member states and of the European Commission which started in 2015 and was officially launched, alongside a high-level conference in Brussels, in February 2020. Nevertheless, its impact on the development of a forest-based bioeconomy in the region is yet to be seen.

Given the relatively limited access of Romanian entities to the Framework Programme funding, the obvious alternative for funding forest-based research would be through securing national funding. The National Plan for Research, Development and Innovation for 2015-2020 (PNCDI III) adopted through Governmental Decision 583/2015, while it does not earmark funding for forestry research, it does put forward bioeconomy as a priority area for smart specialization, next to ICT, climate change and nano-technologies.

Furthermore, through Programme 3 – Cooperation at the international and European level, it has set up the legal framework for the participation of Romanian entities in ERA-NET Cofund actions, that is, research projects funded jointly by the European Commission and the member states via the calls for proposal organized directly by the ERA-NET project. Notwithstanding, the 2017-launched ERA-NET Forest Value

has already issued two joint calls (2017 and 2021) without Romanian participation.

In lieu of a conclusion, while Romanian forest research entities do participate in forestry research EU-wide, there remains a significant untapped potential for the development of a knowledge-based forest bioeconomy, urgently needed in the current context of socio-economic transformation. The question – whether citizenry in general and forest policy actors, in particular, are already involved or will continue to be actively involved in the development of the sector – will be discussed in the following sections.

Take-home messages:

- The EU-funded forestry research increased in line with the increasing share of the EU's Framework Programme for Research and Innovation in the EU budget, from one Multiannual Financial Framework to another, in particular from FP7 (2007-2013) to Horizon 2020 (2014-2020) and is projected to increase further under the recently adopted Horizon Europe (2021-2027).
- The EU funding to forest research and innovation represents only a minor part of the national funding dedicated to research, which has a share in the EU's GDP of around 2.5% as of 2020.
- There is a direct relation between the share of research funding within the GDP of a member state and its overall success in participation in projects funded through the Framework Programme. To enhance the performance of low-performing member states, mostly the 'EU-13' (new member states, acceded from 2004 onward), since Horizon 2020, the 'Spreading Excellence and Widening Participation' chapter has been introduced which aims to "to reduce disparities and the existing divide in R&I performance" by sharing knowledge and expertise across the Union.
- The uneven development of forest-based bioeconomy in Europe is discussed in a number of studies, reveals a high centralization of the relevant research to a few countries and organizations from North-Western Europe, while Eastern Europe remains inadequately integrated into the European research network. Romania is still to obtain funding for a project in a forestry-related area under the Widening Programmes.

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2.1 Socio-technical Transitions and Wood-based Innovations

Julia Wenger, Michael Kriechbaum and Tobias Stern

Innovation plays a central role in the transition towards the bioeconomy. Forest-based industries in Europe are facing structural changes in global markets, which induces Schumpeterian creative destruction processes, where old strategies and business models slowly get overtaken and replaced by new concepts, product portfolios and models (Hetemäki et al. 2014). Thus, these changes can also be seen as key drivers for the self-renewal of such industries (Näyhä et al. 2014). In Romania, like in many other countries, the forest-based sector still relies on traditional business models, market structures, and courses of action (see chapter 2.3). Understanding how to navigate such multifaceted transition processes becomes particularly important. Below, we outline some useful heuristics that innovation scholars have elaborated over the years to help professionals, academics, and policymakers to better manage Romania's transition towards a forest-based bioeconomy.

Recent examples of industry transformation processes can be seen in the pulp and paper industry. The pulp and paper sector has gone through several market fluctuations during the past decades in Europe, but in Romania, the wood pulp production has been eliminated completely since 2010 (see chapter 2.3). One way to revitalize this sector and generate significant additional revenues is to convert the existing infrastructure into biorefineries and expand the product portfolio accordingly. More generally, biorefineries aim at sustainably processing biomass into a spectrum of marketable products (food, feed, materials, chemicals) and energy (fuels, power, heat) (IEA Task 42 definition), and are seen as one of several promising options for advancing the vision of a circular forest-based bioeconomy by partly substituting non-renewable materials and valorizing residue streams. In addition to the biorefinery concept, there are also other (old and new) technologies that allow for wood to replace materials such as steel, concrete, and petroleum in various applications (Leskinen et al. 2018).

While the ongoing structural changes within the forest-based sector are associated with further demand for new technologies and applications, the resulting innovations differ in terms of their degree of novelty. For example, think of the reconsideration of woody biomass for energy production. Although wood served as a source of energy for more than a million years, its perception and role in overall energy production has declined. Only some 20 years ago, woody biomass applications for energy purposes – including, e.g., central heating plants, pellet heating systems, biofuels, and combined electricity heating plants – were reinvented as part of renewable energy systems. While both technological and business-related innovations are being developed in this innovation-field, the larger part of the associated products and technologies can be described as rather established. This is similar for the use of wood-based fibers (such as rayon and lyocell) for textiles, the use of wood in conventional packaging applications, and multi-storey wood construction. However, the envisioned transition towards a circular forest-based bioeconomy is also associated with innovations that show higher degrees of novelty. Examples might be the use of lignin as a feedstock in chemical industry to produce, e.g., surfactants, binders, dispersants, concrete admixtures, various resins, and foams (as a polyol or phenol substitute), as well as carbon fibers, composites, and blends (Dessbesell et al. 2020; Wenger et al. 2020). In recent years, the idea of using wood in vehicle construction has been taken up again and pursued in various research projects (e.g., HAMMER, NIOS, and

Wood C.A.R.). Results so far show that wood is a promising material from a technical point of view (Müller et al. 2019) and that, by substituting a steel component with a wood-based multi-material system, the weight of the vehicle can be reduced (Kohl et al., 2016).

So far, how ever, many wood-based innovations appear to have difficulties in gaining a foothold in existing markets, as they rarely fit into established sectoral systems and their market diffusion can disruptively change existing structures. This situation is well described by the so-called multi-level perspective (MLP), which provides a conceptual understanding of the conditions that must coincide to overcome the entry barriers of innovations (Geels 2004) (Figure 2.1). According to the MLP, established sectors are characterized by stable socio-technical systems consisting of historically grown infrastructure and consolidated actor networks. Not only path-dependencies and lock-in effects have a stabilizing effect, but also the prevailing socio-technical regime, i.e., the (market) rules, norms, routines, and expectations. Due to their rigidity, established socio-technical systems change only in small steps.

While established socio-technical systems are usually associated with incremental changes, path-breaking innovations are developed in socio-technical niches. Such niches offer actors an experimental space protected from the established system for the development of new ideas, technologies, and applications (Schot and Geels 2008). Learning processes, the development of new actor networks, and the formation of alternative socio-technical visions play key roles in the development of innovations in the niche. According to the MLP, 'windows of opportunities' are needed for a wide-scale diffusion of niche innovations. These arise when established socio-technical systems are destabilized from within (i.e., due to contradictions within the regime) or by developments in the socio-technical landscape (Geels and Schot 2007). The latter represents the broader structural developments in which niche- and regime levels are embedded (e.g., societal changes, climate change or economic crises). Such developments have the potential to weaken the established socio-technical system from the outside and, thereby, allow radical innovations and new rules to diffuse 'out of the niche'.

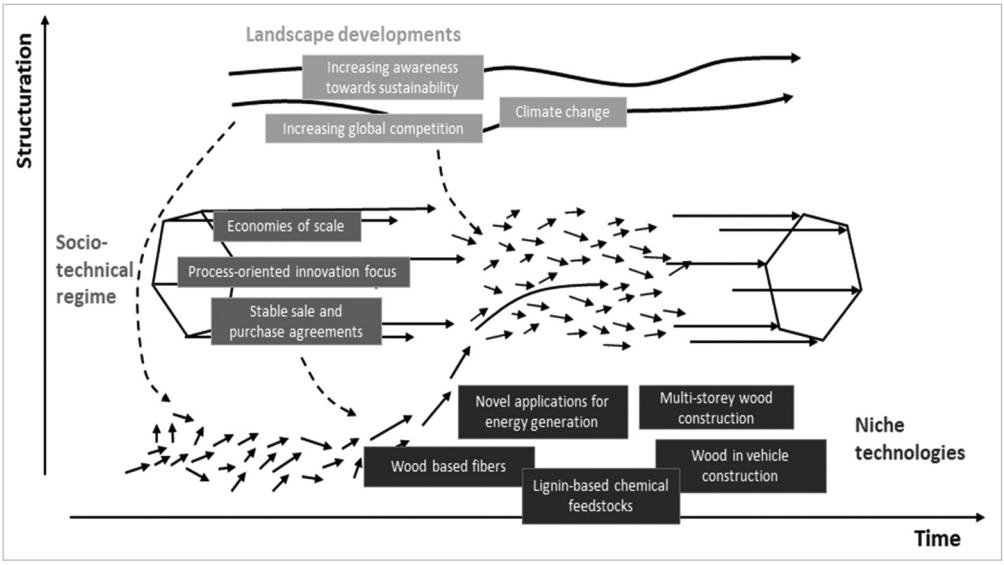

Figure 2.1 Transition dynamics in the forest-based sector (adapted from Geels 2004: 915). While broader developments such as increasing global competition or climate change put pressure on the

dominant structures and sector logics (e.g., emphasis on reducing costs of established products through process optimization and economies of scale), novel wood-based applications and technologies are being developed in niche spaces and might eventually break into and transform the established system.

The MLP narrative well depicts current dynamics in the forest-based sector (see Figure) and has also been used in several studies on the bioeconomy. For example, Falcone et al. (2020) combined the approach with a SWOT analysis in their study of the forest-based bioeconomy in Italy. This approach allowed the authors to develop a better understanding of the maturity of niche innovations and their readiness to enter the established socio-technical system, as well as to assess the impact of niche-external developments on the system and landscape levels. In their study of multi-storey timber construction in Finland and Sweden, Toppinen et al. (2019) used the MLP concept to point out the rigid norms and cognitive structures underlying the construction sector in these countries, which strongly inhibited the establishment of innovative timber construction approaches. The applicability of the multi-level perspective to the bioeconomy is also emphasized by Hermans (2018). However, the author points out that, in the case of the bioeconomy, the boundary between niche and regime levels becomes blurred as efforts to develop a bioeconomy are also supported by established companies. According to Hermans (2018), this could on the one hand help to accelerate the technological maturation process of niche innovations, but on the other hand it might also lead to established players strongly appropriating innovation processes and thus preventing profound transitions.

Bioeconomy innovations currently mentioned in the literature show potential for achieving several dedicated goals of a bioeconomy, such as the reduction of GHG emissions, the replacement of fossil raw materials, and the creation of jobs (Asada et al. 2020). Apart from technologically new approaches, some cases employ established technologies enabling the development of new markets and business models; however, only very few innovations show a truly disruptive character (Stern et al. 2021). This observation can be explained relatively well by the fact that it is predominantly the established actors in the forest-based sector themselves that drive these innovations (Hansen and Coenen 2017). Due to routines, path dependencies, and lock-in effects, radical change usually requires initiative from actors outside the system (Geels 2004). Research on the ambivalent roles of established actors in the context of the bioeconomy is still in infancy (e.g., Strøm-Andersen 2019). Perceptions of different stakeholder groups are represented to different degrees in the scientific literature about the bioeconomy, and there are significant lacks both in the perceived ecological dimension of the bioeconomy concept and in public involvement (Dieken et al. 2021). The inclusion of various potentially affected actor groups (e.g., company representatives, citizens, forest owners) and a better understanding of their perceptions and needs, as well as the consideration of ecological principles (e.g., biodiversity, conservation, recreation) should certainly be part of the future research agenda on the bioeconomy in order to actually contribute to sustainable development (Näyha, 2019; Dieken et al. 2021, Mustalahti 2018).

It can be considered a fact that the targeted innovations tend to lead to a partial expansion of the forest-based sector, in particular by improving its competitiveness with competing feedstocks (e.g., in multi-storey timber construction). This corresponds to the development of new sectoral landscapes, such as those mentioned by Bjöhle & Bröring (2011). For a wide-ranging systemic change in the forest-based area, the herein mentioned innovations could be considered as a prerequisite, however, it is not these innovations alone that will create a transition to a more sustainable circular forest-based bioeconomy. There are major challenges to tackling

today's complex sustainability issues, which are characterized, e.g., by different stakeholder perspectives and conflicting objectives (Tan et al. 2019). The transition to a sustainable forest-based bioeconomy involves versatile actors with differing perspectives and goals (e.g., wood production versus social and environmental objectives such as biodiversity) (Näyhä 2019; Takala et al. 2019). This requires active collaborations, as well as multidisciplinary, multi-objective and participatory approaches, alongside more efficient environmental management practices, and improved and more transparent decision-making processes (Näyha 2019; Dieken et al. 2021, Mustalahti 2018; Tan et al. 2019). Equipped with such wide-ranging analytical tools, stakeholders of the Romanian forest-based sector can better deal with this complexity and resistance to change, and thus steer the much-needed transformation towards a sustainable, circular forest bioeconomy.

Take-home messages:

- Forest-based industries in Europe are facing structural changes in global markets, where old strategies and business models slowly get overtaken and replaced by new concepts, product portfolios and models.
- The inclusion of various actor groups (e.g., company representatives, citizens, forest owners) and a better understanding of their perceptions and needs, as well as the consideration of ecological principles (e.g., biodiversity, conservation, recreation) should be part of the future research agenda on the bioeconomy.
- Targeted innovations tend to lead to a partial expansion of the forest-based sector, in particular by improving its competitiveness with competing feedstocks.
- For a wide-ranging systemic change in the forest-based area, innovations are a prerequisite, however, it is not these innovations alone that will create a transition to a more sustainable circular forest-based bioeconomy. The transition to a sustainable forest-based bioeconomy involves versatile actors with differing perspectives and goals, active collaborations, as well as multidisciplinary, multi-objective and participatory approaches, alongside more efficient environmental management practices, and improved and more transparent decision-making processes.

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2.2 Social Innovation and the Forest Bioeconomy: Challenges and Prospects for Romania

Alice Ludvig and Ada Diaconescu

Introduction

Social innovation is an approach to community development that gained importance during the economic crisis of 2008 as a response to the ensuing challenges such as rural-urban migration, unemployment, and lack of opportunities. For such challenges, social innovation promises to provide opportunities for various economic activities through an enhanced inclusion of civil society. It has become highly prominent among policymakers who developed several EU strategies under the label of social innovation, e.g. for "smart and sustainable growth". Its meaning continues to be vague and has been criticized for not being a truly novel idea but rather a new label for an old concept. Social innovation is generally defined by the European Commission as the development and implementation of new ideas, products, and/or services to meet social needs. For social innovation to become fruitful within a future Romanian bioeconomy, we want to focus here on its main goals and intentions, that is the use of innovation for future sustainable societies. We will address the concept solely from the perspectives of social change or societal activity. This includes both the means and the ends of action in developing new products and services that may help build more sustainable and inclusive societies. The theory behind this is that isolated top-down technological or entrepreneurial innovations will not suffice to address long-term sustainability and combat climate change through an emerging bioeconomy. In a traditional sector such as the forest-based sector, much innovation is grounded in complex socio-economic constellations that are influenced by a number of factors like property rights, climate and market influences, stakeholder opportunities, and institutional settings. Despite manifold policy efforts (Ludvig et al. 2018), many instances of social innovation have emerged bottom-up out of civil society initiatives (Ludvig et al. 2021), and often with neither knowledge nor use of the "social innovation" label (Ludvig et al. 2019). Such initiatives develop bottom-up solutions and transformational change, which can respond more effectively to local realities and interests.

The question that emerges is how social innovation could contribute to the forest bioeconomy in a country like Romania? Romanian bioeconomy seems to be influenced by uneven economic growth between rural and urban areas. Moreover, these challenges may be intensified by climate change and rising demands for forest-based resources in a bioeconomy. In the Romanian rural areas, high levels of unemployment and lack of education opportunities, infrastructure, access to markets, and cultural opportunities, result in emigration to urban areas (see also chapter 1.5) as well as abroad. Social innovation could counteract these tendencies through its holistic and interconnected understanding of social needs and an emphasis on social values. It should help develop sustainable responses to societal and infrastructural challenges in rural areas. For social innovation to happen, it is necessary to build engaged communities, empowered citizens as well as space for cooperation and networking within these local communities.

Vision and Pathways

Such an engagement of civil society in Romania could be framed within a context characterized by the emergence of grassroots movements following the EU Accession in 2007, the newly rising cross-border cooperation, the dominance of large NGOs, but also the existence of bureaucratic barriers to e.g. entrepreneurship. This means that, in some instances, bureaucratic barriers have led to more engagement from civil society. Furthermore, as in other transition countries, there seems to be a low level of community awareness of the potential for participatory initiatives.

Based on the practices and examples studied by the authors in selected case studies, two factors repeatedly appear as critical in the development of social innovations in most regions: the active participation of communities and the existence of supporting policies.

At the EU level, policy packages such as the EU-Green Deal or the EU LEADER/CLLD methods can enhance regional development and bottom-up collaborative activities with the engagement of civil society in urban and rural areas. Yet, these are small activities and the important question of how to pursue up-scaling on a broader level still remains. When scrolling through project databases for such innovation projects in rural areas, only a few renewable energy projects and a few food and farm projects can be found. The same holds for social entrepreneurial projects supported by the International donor funds NESsT that are active in Romania. What all these actions have in common is their "external" base, where the support and funding stem from EU projects and international donor trusts, like NESsT (e.g. NESsT is heavily funded by the Swiss Government or the foundations of US-Aid). One could say that this is better than nothing, but it shows a lack of sustainable national strategies, in the short-, medium- and long-term, for socially innovative measures and support. Indeed, according to the EU's regional innovation scores, Romania is amongst the "modest innovators" (except for some indicators for the Bucharest-Ilfov region). According to the Romanian Civil Society Development Foundation (CSDF, Fundația pentru Dezvoltarea Societății Civile) Romania features high-level economic activities in associations compared to other types of cooperatives or social enterprises. Also, CSDF is mainly funded by the US-Aid program. This leads to an important issue: when projects are over, sustainability is not guaranteed because there are no national support systems. By this, we mean the apparent lack of inter-Romanian national governmental support. Below we outline what would be needed for an "enabling environment" that fosters social innovation in the Romanian bioeconomy. Especially in the renewable energy sector, there seem to be opportunities for bioeconomy in terms of collaborative projects with the initiative and collective engagement of local communities. But these need support measures.

Hence, we define the following critical factors for the active involvement of civil society in developing a bioeconomy (Ludvig et al. 2019): availability of funding, community empowerment, networking support for entrepreneurial activities, dissemination of information, and training and awareness-raising. For these factors to occur and become influential, an enabling policy environment is crucial, which can be defined as direct political support, expressed in laws, rules, standards, and quality criteria, strategic and technical guidance, and also the rhetoric support of political decision-makers. This way, the enabling policy environment may:

- **Encourage the understanding and adoption of institutional forms** of organization

and collaboration (e.g., cooperatives, associations, NGOs) with relevant stakeholder groups;

- **Enhance specific policies and rules** taking into account the diversity of local situations, actors, and circumstances. For monetary policy instruments, flexible and continuous seed money is most crucial for enabling social innovation in countries like Romania.
- **Design general policies integrating the former elements and tailoring them** to support territorial and value chain development initiatives.

The ongoing international support by EU projects and international trusts and funds should have a resonance at the Romanian governance levels e.g. resulting in public-private partnerships for bioeconomy activities at the local level.

Challenges hindering social innovation in a Romanian bioeconomy

Especially in countries with urban-rural societal divides, a long-term perspective needs to be adopted for facilitating social innovation at the local level. The principal conditions that hinder social innovation in Romania can be identified as:

- **Short-term political priorities** and direction can prematurely end promising social innovation projects. Evidence shows that social innovation initiatives are often long-term projects and societal processes, and their results are not always immediately visible. The long-term time-spans of such projects are not always understood by policymakers.
- In some local areas, conventional government/governance institutions and actors are **not supportive of "bottom-up" civil society engagement.** However, bottom-up approaches can have advantages for conventional government notions, as they reduce risks of social unrest and strengthen the trust and support of political institutions and the legitimacy of political regimes. This is the result of intense learning processes.
- Finally, **inadequate understanding of social innovation** can lead to policy failures, for example when the focus of innovation programs is solely on the **technical outputs**, which are often immediately measurable but are less effective than the changes to social practices that take place as part of social innovation.

Prospects and key features for policy support

Table 2.1 outlines the principal policy features that support the establishment, continuation, sustainability, replicability, and scaling-up of social innovation in rural areas. It is important to note that overlaps amongst the policy support features are quite likely to occur. The forest sector and its related value chains, including ecosystem services, need combined policy instruments, e.g. policies that combine legal support with monetary support or financial incentives, or information and education combined with monetary policy support. Table 2.1 synthesizes the opportunities for Romania.

Table 2.1 Key features of policy support according to types of policy instruments for social innovation

Main Type of Support for sustainability	Support for replicability/ scaling-up	Specific type of Policy Instruments	Key features identified for the Romanian context
Legal: Top-down and contextual support. Social innovation can also trigger and influence new legislation from the bottom up in later stages.	Replicability and further scaling up first need better implementation practice, legislation and the overall political will of the responsible authorities.	Legal instruments (laws, regulations, directives, decrees, constitutional laws)	Improving forest areas' governance through the implementation of participatory approaches.
Economic: Top down and contextual support, provision of means and resources, requires seed money and follow up funding (continuity is key)	Such examples need longer-term financial support. Initial "seed money" can be sufficient in early stages but continuous monetary support is required for the social innovation to scale up and scale out	Economic instruments (taxes, fees, subsidies, interest-free loans, general public procurement, project financing)	All EU funded bio economy projects (e.g., investments into new sustainable products and services, investments into new biomass plants)
Information and awareness: At the local level, local support via technical training and education.	The key for gaining resilience and for up scaling is the investment in "networking" across and beyond regions; others need to know about and learn from these examples.	Information tools (studies, brochures, awareness campaigns, websites, events, labels and branding); most important in rural areas: provision of information, understanding and awareness raising	Information, training and marketing by World Bank, education and training funded by the government, the EU and the UN, building of resilient food security systems for vulnerable parts of the rural population.
Cooperation support: At the local level, local support for interaction and community action. Policy support in facilitation and sometimes public-private partnerships.	E.g. for up-scaling innovation, local "hubs" could be created. Further investment may include facilitation of networking and cooperation between all institutional entities and other sectors in the region. "Innovation brokers" as identifiable actors for support may be a further option.	Partnership instruments and cooperation (voluntary agreements with companies, partnerships and partnership projects)	Supporting ecosystem services and the related organizations through e.g. public private partnership programmes, climate-resilient multi-purpose forest management.

Main Type of Support for sustainability	Support for replicability/ scaling-up	Specific type of Policy Instruments	Key features identified for the Romanian context
General regional development support: Preparation of the ground with experience from other initiatives, e.g. general land reforms or local development plans indirectly intended for the bioeconomy. For social innovations to strive here and become sustainable, the previous support in the region by rural development policies and other initiatives is crucial.	Most important for this type of social innovation in Romania is the investment in general social capital, and the provision of a "space for action" and suitable opportunities (cultural, social, economic) to the region.	Former regional or local hybrid, planning and strategic instruments (plans, strategies, action plans, new programs) not directly aiming at social innovation	General rural development programme for rural areas such as LEADER/ CLLD funded projects, preparing the ground for social innovation to emerge.

Source: developed by the authors, the types of policy instruments are informed by Baldwin et al. 2011 and Bemelmans-Videc et al. 2003

Conclusions

In the specific realm of social innovation for a resilient forest bioeconomy, the provision of opportunity structures, the strengthening of local social capital in combination with the provision of sufficient education and training are the most enabling factors for social innovation in Romania. In concrete terms and derived from the examples of civil society efforts mentioned above, this includes the development of social entrepreneurship also in relation to small-scale farming and forest management.

Direct political support expressed via laws, rules, standards and quality criteria, strategic and technical guidance, and also the rhetoric support of political decision-makers are only a part of an enabling environment for social innovation. In addition, political culture, e.g. a culture of openness, flexibility, and innovation, can have significant effects on people's values, beliefs and actions. Hence, it is the indirect enabling conditions that function as one of the keys to the emergence of social innovation for a Romanian bioeconomy. In regions with poor infrastructure, there will be a need for greater facilitation and financial support for social innovation than in rural areas. Social innovation does not need to be strictly regulated. Instead, policies are likely to foster social innovation when they successfully prepare the ground and provide "room for manoeuver" for local communities to act upon- and develop- their ideas. Policies need to invest in knowledge exchange, capacity building, and infrastructure in rural areas (see table 2.1, above). However, social innovation in support of a Romanian bioeconomy would benefit from some form of cohesion tool, or "hybrid" organization or body (e.g. an innovation broker) to tackle divisions between policy sectors. For this to happen, the benefits of

social innovation for all stakeholders involved need to be recognized. A future focus on social innovation in Romanian rural areas can be a powerful driver of social transformation towards a bioeconomy. In order to achieve this, tackling poverty, unemployment and emigration need to be prioritized in some rural regions. Hence social innovation is likely to hold an important socio-economic role. As outlined above, to facilitate social innovations in local communities and to support local needs and resources, action and engagement are required not only from the civil society but also from the local and national governments.

Take-home messages:

- Social innovation is a broad concept that should respond to societal challenges with the inclusion of civil society actors.
- For social innovation to happen, it is necessary to ensure engaged neighborhoods, empowered citizens as well as create space for cooperation and networking within local communities.
- Local communities and groups have to feel entitled and empowered to address societal challenges.
- There is a need for adequate and sufficient funding to be available at community levels for small-scale forest owners and rural communities.
- Small activities do exist in the Romanian bioeconomy, but it is important to pursue up-scaling on a broader level.
- There is ongoing international support by EU projects and international trusts and funds; this should have a better resonance at the Romanian governance levels.

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2.3. Romanian Production and International Trade of Forest-based Products

Marko Lovrić and Alexander Moiseyev

Introduction

In order to plan the development of the forest-based bioeconomy in Romania, we have to better understand how forest-based products are produced and traded on the international markets. The direction of sectoral policies is, to a large extent, based on the availability of reliable background data on the subject matter. The forest-based bioeconomy is no exception, and one of the most reliable data about it is the production and international trade of forest-based products. Production data is prepared by competent ministries and used for international statistical reporting. This data is less reliable than the international trade data, which is aggregated by national customs organizations and then compiled by World Customs Organization. International trade data is the most reliable data source on economic activities that exists on a national level, where its trends can (with a low margin of error) point to the overall direction of the economy. On the other hand, the national production data is more useful as international trade data cannot take into account national consumption and it is therefore difficult to directly link it to other economic indicators such as employment. Jointly, these data sets provide a clear overview of national (sectoral) economic activity – and this is what we produce for the case of the Romanian forest-based economy in this study. We refrain from making inferences on the relationship between economic indicators; rather, we focus on the descriptive presentation of the data.

Materials and Methods

The first step in the analysis is to define what the forest-based bioeconomy products, within a given commodity classification, are. The selection of products is in HS02 (Harmonized Nomenclature classification of 2002) on a six-digit code of detail. Aside from traditional forest-based products such as sawnwood and wood-based furniture, we also selected new and novel products that use wood or by-products from the industrial processing of wood (e.g., black liquor from the pulping process) as feedstock. Novel products are likely to increase in market share in the near future. New products should have a Technology Readiness Level between 5 and 9 to indicate that such products could come to the market in the next 10 years. To create a HS02 list of new or novel wood-based products, we have utilized the work of Hassegawa et al. (2021) who have, for this purpose, conducted a combination of scientific and grey literature review, following a structured web search, interviews with experts from the industry and research institutes, and a survey with organizations developing or producing new and novel wood-based products. In total, 253 commodity codes have been selected under the headings:

- Code 44 (Wood and articles of wood; wood charcoal),
- 45 (Cork and articles of cork),
- 46 (Manufactures of straw, esparto or other plaiting materials; basketware and wickerwork),
- 47 (Pulp of wood or other fibrous cellulosic material; recovered (waste and scrap)

paper or paperboard),

- 48 (Paper and paperboard; articles of paper pulp, of paper or paperboard), and selected forest-sourced six-digit codes under headings),
- 49 (Printed books, newspapers, pictures and other products of the printing industry; manuscripts, typescripts, and plans),
- 94 (Furniture; bedding, mattresses, mattress supports, cushions and similar stuffed furnishings; lamps and lighting fittings, n.e.c.; illuminated signs, illuminated name-plates and the like; prefabricated buildings).

The list of commodities also hosts innovative forest-based bioeconomy products out of these headings, e.g. 280300 (Carbon; carbon blacks and other forms of carbon); 290531 (Alcohols; acyclic, diols; ethylene glycol; ethanediol); 290532 (Alcohols; acyclic, diols; propylene glycol; propane-1, 2-diol); 291241 (Aldehydes; aldehyde-ethers, aldehyde-phenols and aldehydes with other oxygen function, vanillin; 4-hydroxy-3-methoxybenzaldehyde) and 550490 (Fibers; artificial staple fibers, other than of viscose, not carded, combed or otherwise processed for spinning).

Validated and cleaned trade data set by the French Institute for International Economics (BACI data set; Gaulier and Zignago, 2010) has been used. HS02 data set covers 2002-2019 period. This entire data period has been used in the analysis. 2019 constant prices in USD are used. Values focused only on Romania are based on 2019 Romanian annual inflation rates (World Bank 2021). For parts of the analysis looking at multiple countries, 2019 constant prices are used, where the World Bank's global inflation rates are used. Apart from this, the descriptive statistical analysis, Revealed Comparative Advantage (RCA) has been calculated for Romania per product by year. The RCA definition of Balassa and Noland (1989) has been used, where the basis for calculation is the scope of selected forest-based products (and not the all traded products). RCA values higher than 1 mean that a given country has a revealed comparative advantage for that product. On a mock example, if the export of sawnwood accounts for 10% of global exports of forest-based products but 20% of Romanian forest-based exports, then Romania has an RCA of 2 (i.e., 20/10) for sawnwood. Data manipulation and preparation has been conducted in R programming environment (R Core Team 2020.), while network analysis has been conducted in UCINET (Borgatti et al. 2002).

Results

Trends in production and consumption

Long-term trends in the production of major forest products are shown in Figure 2.2. The total roundwood removals maxed out at 23,45 million m^3 back in the1980s. During the transition from a planned to a market economy, roundwood removals dropped down almost three-fold in the 1990s (min at 8.84 million m^3) with the following gradual recovery to 15-16 million m^3 level after 2000. In terms of volume, sawnwood was and still is the most important wood-based product produced by the Romanian forest sector. The total sawnwood production reached 5 million m^3 at the beginning of the 1980s. However, sawnwood production followed a similar to roundwood production trend with a decline of almost three-fold in the middle of the 1990s, during the aforementioned transition, from a planned to a market economy.

A similar trend can be observed also for all other major forest products including wood-based panels, pulp and paper.

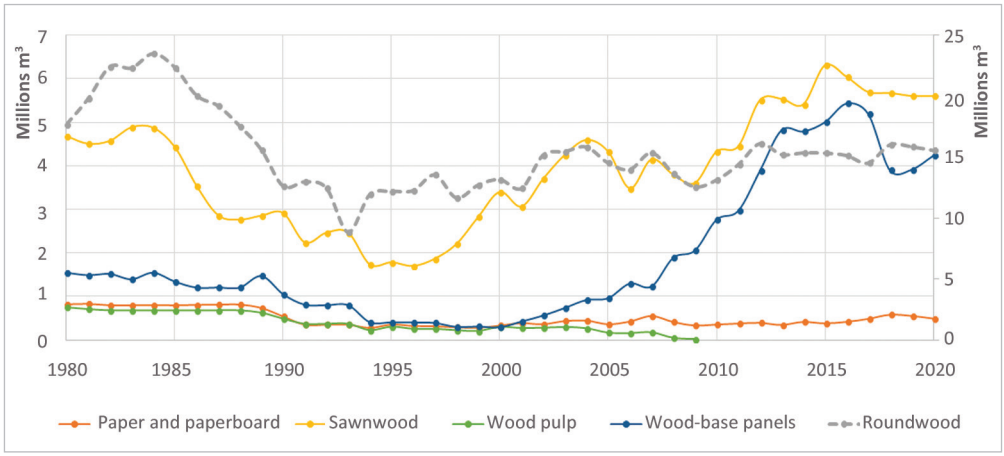

Figure 2.2 Romanian main forest-products production – a historic development, FAOSTAT, 2021

The start of the recovery trend for sawnwood production can be noted as starting from the late 1990s until 2015 when the total volume of sawnwoon reached 6,3 million m³. The latter volume is higher than the max volume reached during the 1980s, which was also supported with the higher roundwood harvest of the 1980s. Higher sawnwood production during the 2010s was achieved with lower roundwood harvest. However, higher sawnwood production level with lower roundwood removals in the 2010s was achieved with growing net imports of industrial roundwood since 2005 with a max level of 1.6-1.7 million m³ during 2015-2016 (Figure 2.3). Apart from sawnwood, the wood-based panel production trend was the fastest-growing after 2000. Wood-based panels production maxed out at 5,4 million m³ in 2016 with the following sharp decline down to 4 million m³ during 2018-2019. Sawnwood production volume started to decline after 2015, although at a lower rate compared to wood-based panels.

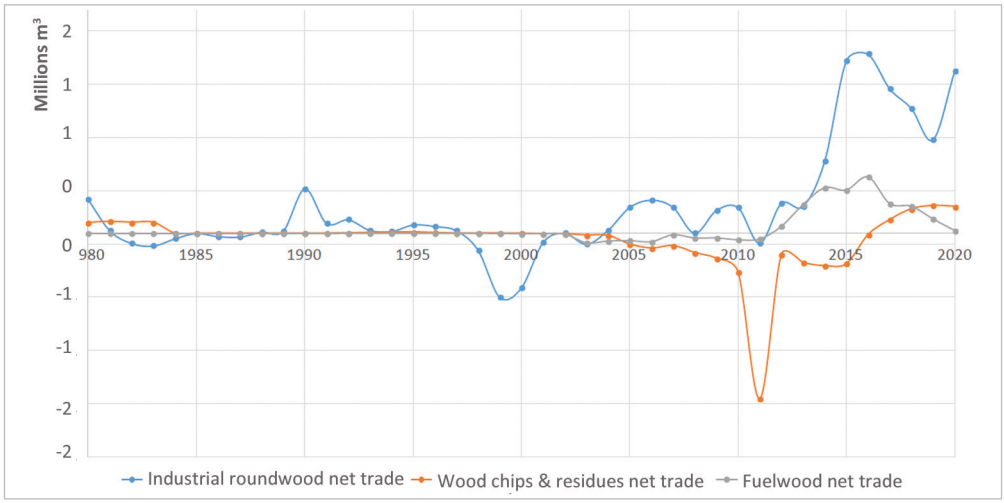

Figure 2.3 Net trade of wood, million m³ (net import above zero and net exports below zero level), FAOSTAT, 2021

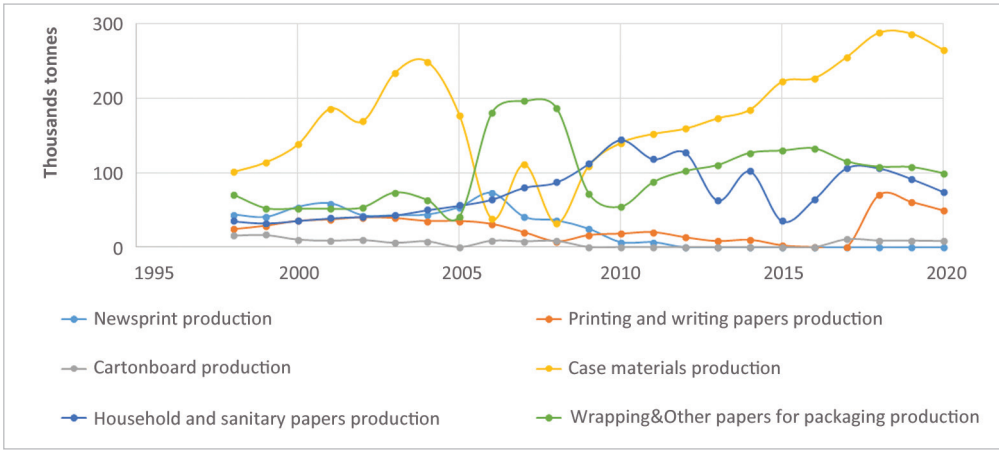

Figure 2.4 Paper and paper boards production – a historic development, FAOSTAT, 2021

The pulp and paper industry in Romania was sufficiently developed to satisfy domestic demand back in the 1980s and provided 25% export from the production level. During the 1990s Romanian pulp and paper industry was going through a substantial decline in both demand and production similar to the rest of the forest industry. The Paper industry was producing mainly wrapping and packaging paper (almost two-thirds of total paper production in the 1980s) and graphic papers. After 2000, the demand and production of paper and paperboards started to recover. Nevertheless, paper production recovery could be noticed in the case of other papers and paperboards – the main paper grades benefiting from growth were case materials, wrapping, and other papers produced mainly for packaging and sanitary papers (see 2.4). This recovery trend was mainly driven by strong demand growth for case materials and other papers for packaging (Figure 2.5). Printing and writing papers also show a strong demand growth after 2000. However, this demand was primarily supplied from the growing paper imports (see Figure 2.6). Printing and writing papers demonstrate the highest net import among other paper grades, while carton-board shows the second largest growing import. Sanitary paper was the only grade, showing a net export trend for an extended period (between 2010 and 2018), however, the latter trend is reversing, demonstrating near-zero net trade in 2019-2020. Growing production of case materials was supported by the growing use of recycled paper, while needed wood pulp supply was increasingly imported. Since 2010 wood pulp production has been eliminated completely.

After the market transition of the 1990s, most foreign investments were directed into woodworking and furniture industries. It should be mentioned that pulp and paper industries are highly capital intensive, and modern investments into this sector are mostly done globally by multinational companies. The economy of scale acts as an additional barrier, whereby Romania cannot offer good economic returns. At the same time, most Romanian woodworking and furniture companies are small to medium size and the woodworking industry does not require very high investments. The main attractiveness for the investments into woodworking and wood furniture industry was initially related to low wood and labor costs. The latter factors favored more rapid growth of sawnwood and wood-based panels until 2015-2016 (see Figure 2.7). Export was the main driving force behind this growth during the 2000s and the early 2010s (see Figure 2.8). However, this growth reversed into an export decline around 2015.

While coniferous sawnwood export started to decline sharply from 2015, domestic consumption increased twice in one year from 2014 to 2015 (see Figure 2.9). This sharp consumption growth was driven by a 10 % surge in the Romanian construction sector.

After 2015, domestic demand became the main driving force behind the coniferous sawnwood market in Romania. A similar trend is observed for particleboard, while changes in exports and domestic consumption of other wood products were more modest. In addition to wood products, Figure 4 shows the development of wood furniture exports in thousand metric tons (right Y-axis). With a certain delay, wood furniture export shows a similar trend to coniferous sawnwood export. Wood furniture exports are recovering after a sharp decline in the middle of the 1990s with the maximum level in 2016 and following a decline in exports after 2016.

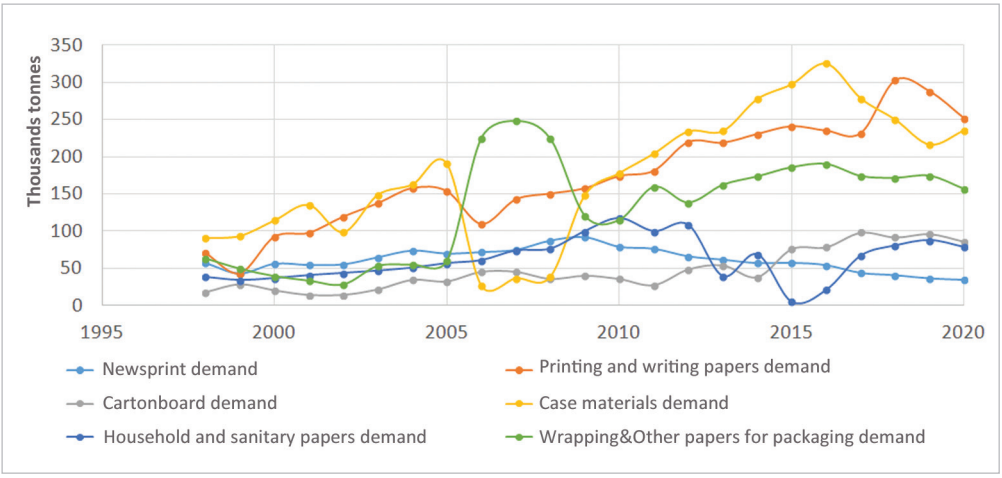

Figure 2.5 Paper and paper boards apparent consumption – a historic development, FAOSTAT, 2021

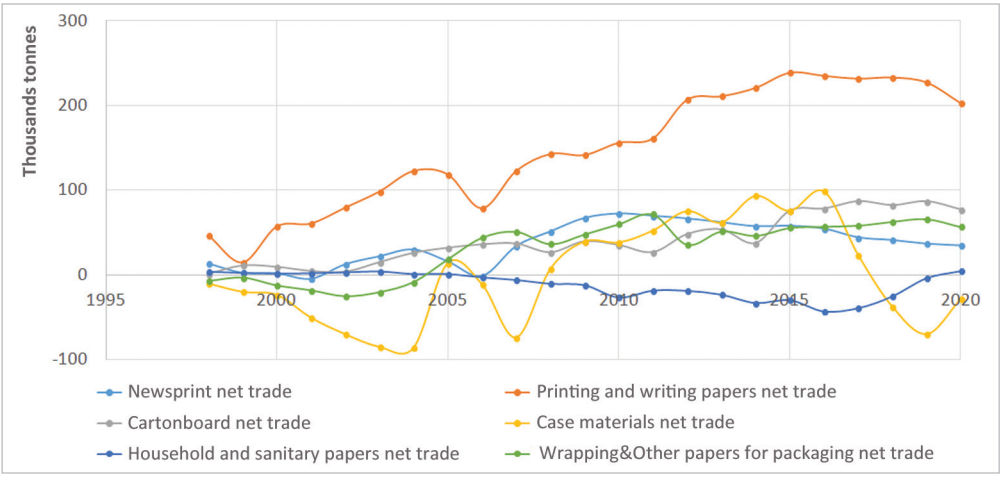

Figure 2.6 Paper and paper boards net trade – a historic development, FAOSTAT, 2021

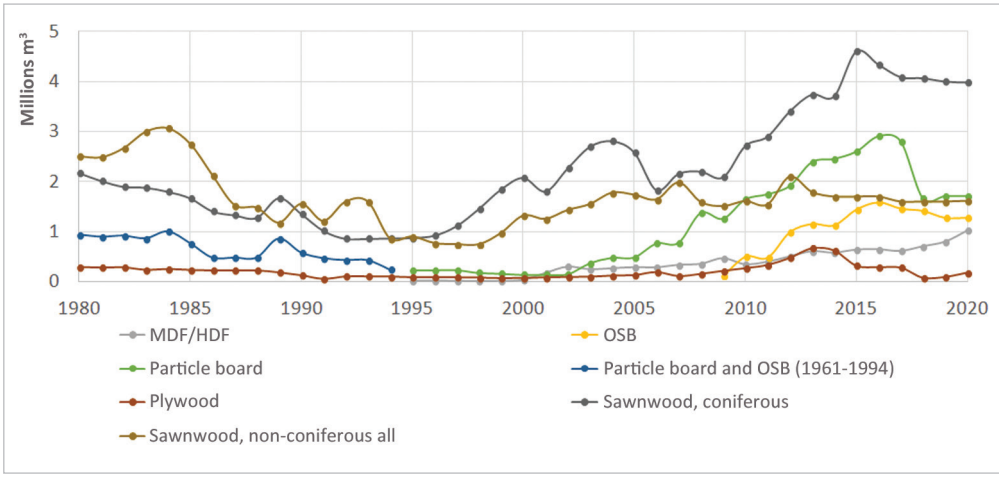

Figure 2.7 Wood based panels production – a historic development, FAOSTAT, 2021

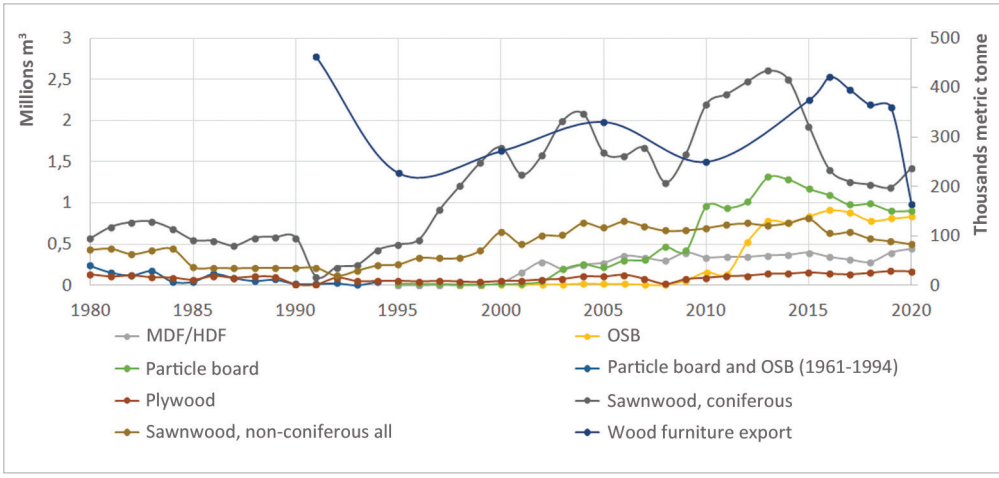

Figure 2.8 Wood based panels export – a historic development, FAOSTAT, 2021

Despite a good growth of Romanian woodworking industries (sawnwood and wood-based panels) during the 2000-2015 period, the main trend in the production, export and consumption after 2015 is stagnation and decline, while imports for most paper and wood products are growing. The main reason for the major shifts in the Romanian forest sector trends are changes in the domestic forest legislation adopted in 2015 and the pressure exerted by Green organizations on wood processors concerning the origin of sawnwood resulting in an import surge compared to previous years (Dobrescu, 2017).

A regulation from RNP Romsilva, the Romanian Forestry Agency, has led to an increase in starting prices at the auctions organized in December 2015, which sparked fears among producers of the worst forestry crisis after the transition from a planned economy during the 1990s. High prices for Romanian timber led to a competitiveness crisis of the entire wood processing industry, including the furniture industry (Business Review Magazine 2016).

The problems of limiting the volume of standing timber for auctions by Romsilva and the high starting prices persisted for several years (Global Wood Markets Info 2019).

Figure 2.9 Sawnwood and wood based panels apparent consumption – a historic development, FAOSTAT, 2021

As a result of the Romanian transition from planned to market economy, the forest sector was going through a steep downturn. Since 2000 this trend was reversed, when the Romanian forest sector demonstrated recovery and a healthy growth of most parts of the forest sector excluding pulp and paper during the 2000-2015 period. The furniture industry was and still is one of the most competitive and high value-added sectors in Romania. In 1989, the Romanian furniture exports were ranked # 5 globally, # 4 in EU27 and # 1 among EU13 Eastern European countries, while the wood furniture industry represented 98% of the total furniture exports (UN Comtrade 2021). After transitioning to the market economy in 2000, the Romanian furniture exports were ranked # 27 globally, # 15 among EU27 and # 5 among EU13 countries, and the wood furniture industry constituted 80% of the total furniture exports. In 2015, the Romanian furniture exports were ranked # 18 globally, # 10 among EU27 and # 3 among EU13 countries with 42% of wood furniture share. And, in 2020, the Romanian furniture exports were ranked # 19 globally, # 11 among EU27 and # 4 among EU13 countries with 39% of wood furniture share, which is slightly worse than in 2015, but it indicates a change of trend of worsening competitive position of the Romanian forest sector, triggered by limited volume of standing timber for auctions combined with high starting prices since 2015.

Trends in trade

The total value of Romanian exports in the observed period is relatively constant, with 3.58 bil. USD in 2002, 3.54 bil. USD in 2019 and a maximum value of 4.25 bil. USD in 2014. When these values are disaggregated to the level of individual product groups (see Figure 2.10), the same horizontal trend can be observed.

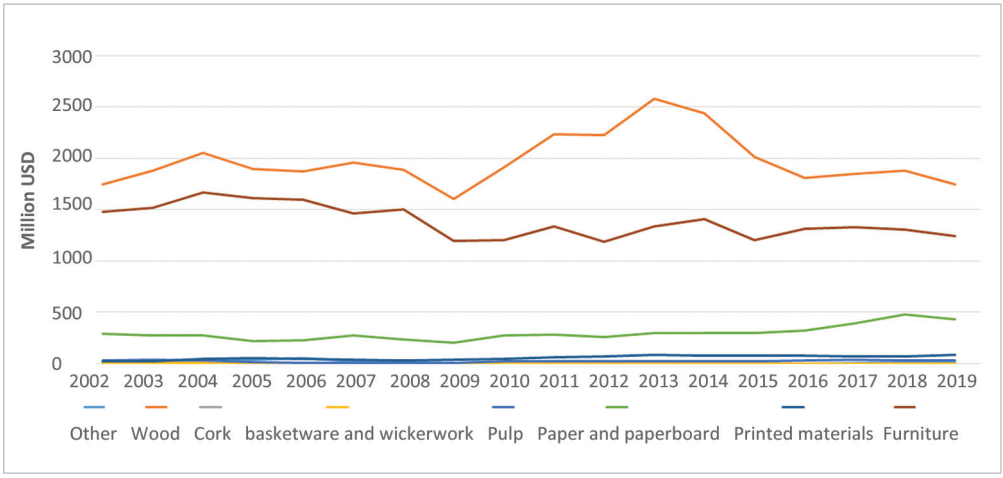

Figure 2.10 Romanian exports by product group, 2002-2019 period

Looking at 2019 values, the most prominent exporting group of products is wood (1.74 bil. USD), followed by wooden furniture (1.24 bil. USD) and paper and paperboard (430 mil. USD). The value of all other commodity groups is below 100 mil. USD; i.e. for printed materials it is 83 mil. USD, for pulp products it is 31 mil. USD, for other products it is 6.9 mil. USD, for cork products it is 1 mil. USD and for basketware and wickerwork it is 0.2 mi.USD.

Romanian imports (see Figure 2.11) have increased in the observed period from 1.7 bil. USD in 2002 to 3.1 bil. USD in 2019, with highest values reported in 2008 (3.8 bil. USD) and 2007 (3.4 bil. USD). Looking at 2019 values, the most prominent importing group of products are paper and paperboard (1.3 bil. USD), followed by wood (831 mil. USD), furniture (572 mil. USD), printed materials (119 mil. USD), other products (101 mil. USD), pulp (99 mil. USD), cork (9 mil. USD) and lastly basket ware and wickerwork (4 mil. USD).

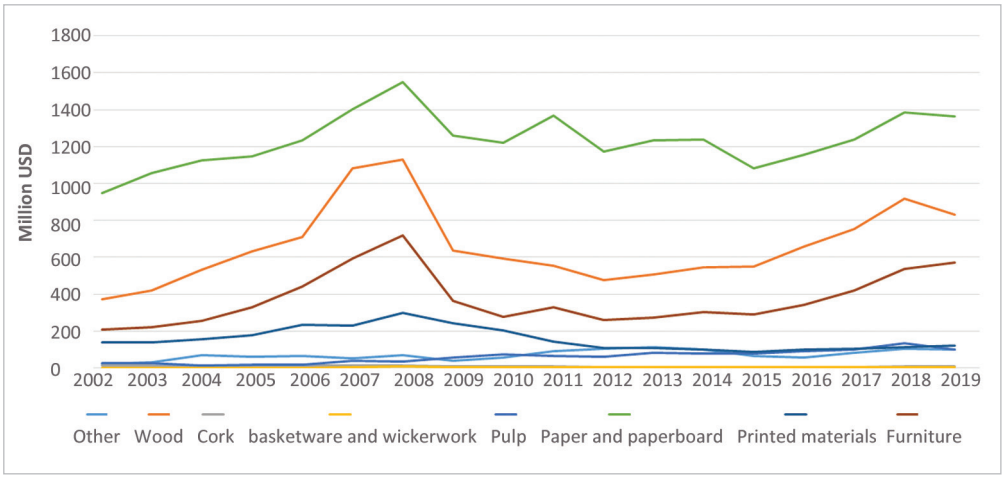

Figure 2.11 Romanian imports by product group, 2002-2019 period

The next step of the analysis was to look at the Romanian RCA per forest-based product. This information is presented in Figure 2.12 on a product level for the 10 products that have the largest average RCA value in the observed period.

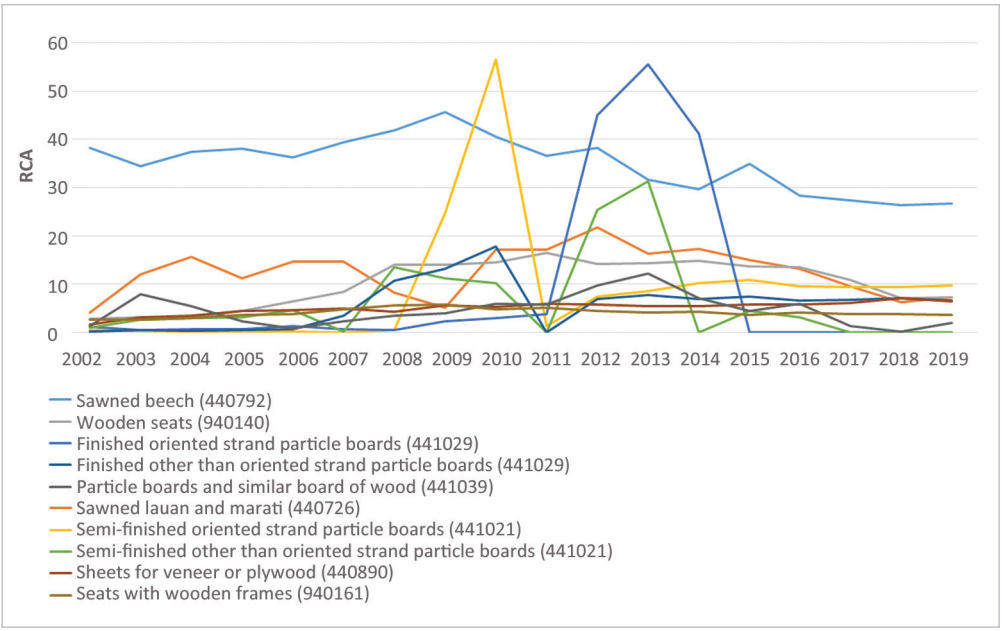

Figure 2.12 Romanian RCA by product

Looking at 2019 values, Romania has the largest RCA in sawn beech wood (26.6), followed by semi-finished oriented strand particle boards (9.7) and wooden seats (7.3). The RCA values have not changed much in the 2002-2019 period, except for three products. Finished oriented strand particle boards (441029) and semi-finished other than oriented strand particle boards (441021) had a peak RCA in 2013, then decreased in the next couple of years to zero value. This type of trend is typical for commodity re-classification and does not represent a true trend in trade value. The same cannot be stated for semi-finished oriented strand particle boards (441021) which had an RCA peak in 2010 (56.6), and then levelled off to a RCA around 10 in the subsequent years. Code 441292 (Plywood, not consisting only of sheets of wood, with at least one ply of tropical wood, not containing an outer ply of non-coniferous wood) has been removed from the RCA calculation due to a large deviation in values. It is worth checking for which products did the Romanian RCA increased the most in the observed period. The top-five products for which Romania has changed its export profile the most are mattresses with cellular fibers (code 940421, 2019 RCA of 3.4), interleaved manifold paper and paperboard (code 482040, 2019 RCA of 4.8), tissue and napkin stock (code 480300, 2019 RCA of 1.6), paper albums for collection (code 482050, 2019 RCA of 1.6) and waste and scrap paper (code 470730, 2019 RCA of 0.5).

In 2019, Romania traded in forest-based products with 156 out of 236 countries in the world (as based on country-level postal codes), which cover almost the entirety of the global trade value in selected commodities. This trading network is visualized in Figure 2.13. Romania

is marked in the center with a red circle, and its trading partners are marked with grey squares. The size of these symbols reflects their value in trade (i.e. sum of their exports and imports). Only Romanian trade is shown with grey lines and red arrowheads. Only trade flows with a value greater than 10 mil. USD are shown, where the size of the arrowheads is scaled to the value of the trade flow.

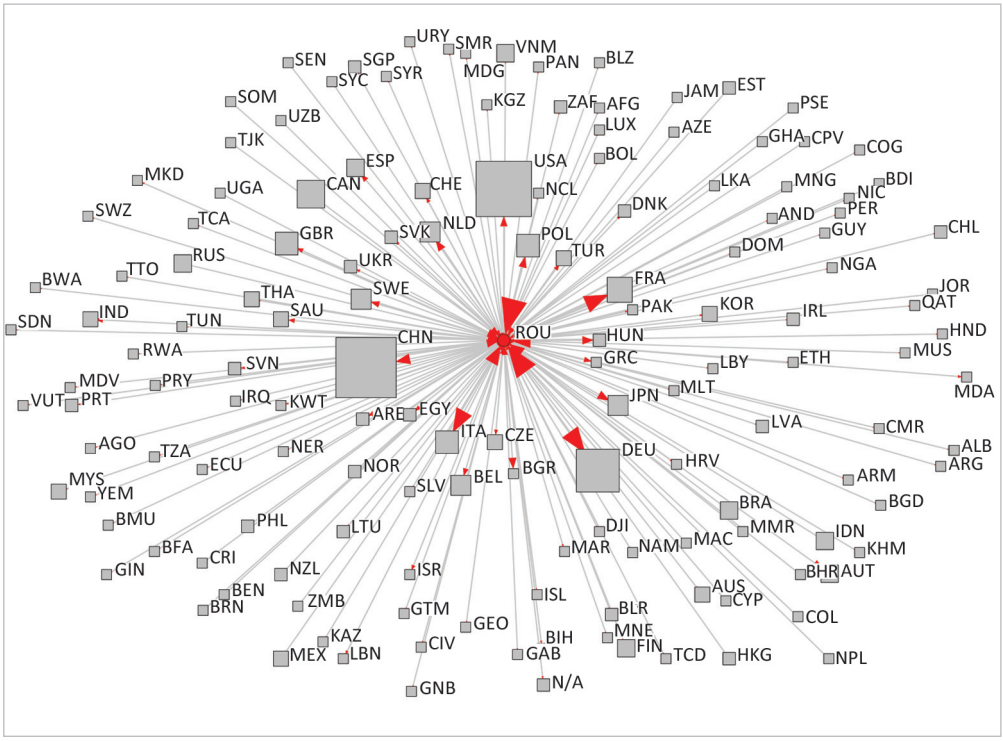

Figure 2.13 Romanian trading network in 2019

In terms of 2019 exports, Romania's biggest trading partners were Germany (359 mil. USD), France (325 mil. USD), Italy (321 mil. USD), China (192 mil. USD), Japan (149 mil. USD), Netherlands (138 mil. USD), Hungary (136 mil. USD), Poland (134 mil. USD), Bulgaria (128 mil. USD) and Austria (127 mil. USD). In terms of 2019 Romanian imports, Romania's biggest trading partners are Poland (490 mil. USD), Germany (438 mil. USD), Hungary (271 mil. USD), Italy (248 mil. USD), Austria (201 mil. USD), China (142 mil. USD), Ukraine (131 mil. USD), Russia (120 mil. USD), Slovakia (117 mil. USD) and Bulgaria (102 mil. USD). The above-listed countries are either major global trading countries and/or close neighboring countries, which is a typical ego-trade network structure. The prevailing characteristic of the Romanian trading network is that, in the majority of cases, its trading partners have many trading partners themselves; which might be detrimental in terms of national bargaining-power on a bilateral trade level. These type of notions can be tested with outdegree (export) and indegree (import) beta centralities (Bonacich 1987), which reflect the level of export and import trade centralization on a given individual country. In the Romanian ego-network (comprising

of Romania and its trading partners), the Romanian outdegree beta centrality value is on 61% of the mean outdegree beta centrality value of all countries, whereas for imports it is on 35% of the mean value. This can be interpreted that Romania has a more favorable trading position in terms of its exports than in terms of its imports. As a reference, the dominant trading countries in terms of beta centralities are China (2274% of the mean outdegree and 1317% of the indegree beta centrality), Canada (2008% and 1510%) and the USA (1653% and 3005%).

Discussion and conclusions

In the last two decades, Romanian export values have generally remained constant at about 3.5 bil. USD, dominated by lower-level, added-value wood-based products. This is even more evident when observing Romanian product-level revealed comparative advantages, which are highest for sawned beech wood and semi-finished particle boards. However, relative change in RCA values per product shows that the Romanian forest-based bioeconomy shows signs of specialization towards higher added-value paper products. Imports have doubled in the same period, to 3.1 bil. USD in 2019, where almost half of it falls to paper and paperboard products. Romania trades with the vast majority of countries around the world, predominantly with its neighboring countries or with large overseas countries. It is positioned within a dense network of strong trading countries, where the export trading position is more favorable than the importing trading position.

Take-home messages:

- In the last two decades, Romanian export values have generally remained constant at about 3.5 bil. USD, dominated by lower-level added-value wood-based products;
- The Romanian forest-based bioeconomy shows signs of specialization towards higher added-value paper products;
- Imports have doubled in the same period, to 3.1 bil. USD in 2019, where almost half of it falls to paper and paperboard products;
- Romania trades with the vast majority of countries around the world, predominantly with its neighboring countries or with large overseas countries;
- It is positioned within a dense network of strong trading countries, where the export trading position is more favorable than the importing trading position.

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2.4. Sustainable Forest Management Certification in Romania

Aureliu-Florin Hălălișan and Marius Turtică

Introduction

Achieving sustainable development through responsible forest management has been ardently debated since the early 1970s and 1980s. According to the Brundtland Report, a publication released in 1987 by the World Commission on Environment and Development (WCED) "humanity has the ability to make development sustainable to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs. The concept of sustainable development does imply limits - not absolute limits but limitations imposed by the present state of technology and social organization on environmental resources and by the ability of the biosphere to absorb the effects of human activities" (WCED 1987). Thus, the first definition of sustainable development was introduced. For many companies activating in the 1980s-1990s, the concept of equally weighing economic considerations, with social and environmental aspects was rather novel. Many companies thus began doubling down on their environmental and social commitments. As a result, a new concept of social responsibility of company management emerged, nowadays widely known as corporate social responsibility (CSR).

Forestry companies too embraced this concept, due to the very nature of their business models, which has a direct impact on the natural environment. But their focus needed to go beyond the efficient use of resources and had to take into consideration crucial environmental and social aspects (Toppinen et al. 2014). The concept of CSR was refined over the years, and in 2001, the European Commission described it as a concept through which companies integrate social and environmental concerns into business and in the interaction with various factors involved and affected.

Since then, the forest-based sector is expected to implement responsible practices in wood production and marketing. Private management encourages companies to follow responsible practices including certification and labeling to demonstrate sustainable management and gain market advantages. According to Vogel (2008), the implementation of these sustainable policies is the result of three factors: lack of credibility, legislative requirements, the pressure of stakeholders or/and the change in the good governance regulations.

From the bioeconomy perspective, forest certification can be seen as the way to prove sustainable practices when using increased quantities of biomass along longer and innovative value chains. Certification contributes to creating new chains of custody in the context of biomass utilization and diversification. Like in other countries, forest certification in Romania can be seen as an efficient tool for adding value by creating a demand for certified products. In this way, Romanian companies can take advantage of the opportunity to use a surplus of biomass and forest products. Furthermore, the concept of "sustainable forest management" (SFM) has been harmonized due to the criteria defined by the Second Ministerial Conference on Forest Protection in Europe (H1-Helsinki Resolution) in 1993, but also due to subsequent global meetings (the Intergovernmental Panel on Forests (1995-1997), the Intergovernmental Forum on Forests (1997-2000), the United Nations Forum on Forests in 2001, and the

Johannesburg Summit in 2002). For three decades, the criteria/indicators for evaluating SFM have been important topics of discussion for the development of sectoral forestry strategies.

At the same time, various forest certification schemes building on indicators that evaluate SFM were established. Some of these came as a response to the apparent failure of the 1992 Earth Summit in Rio to produce an agreement to stop deforestation. Different groups of businesses, environmentalists and community leaders came together to establish a voluntary, market-based approach. The main aim of this new market-based approach was to improve forestry practices worldwide[23]. In 1993, the Forest Stewardship Council (FSC) was established as the first worldwide forest certification scheme to improve forest practices through indicators. It brought together large traders (retailers), wood processors, representatives of indigenous peoples and local communities, as well as social and environmental Non-Governmental Organizations (NGOs), thereby ensuring a balanced representation of different economic, social and environmental interests in forest management.

Subsequently, in response to the FSC's apparent blind spots in what concerns the European forest management, small forest owners in Europe initiated a new forest certification scheme in 1999, the so-called PEFC. Since it was initially focused on Europe, the acronym PEFC stood for "Pan-European Forest Certification Scheme". Nowadays, its name has changed to "Program for Endorsement of Forest Certification", and it has a global reach.

Responding to concerns related to the global application of indicators to local conditions, an important step was made by involving standard settings organizations to support countries in developing their national standards. These standards need to be adapted to national legislation and silvicultural technical norms. The national standards (with applicable indicators) were developed by National offices or by accredited Standard Development Groups with large contributions from stakeholders. Transparency with regards to the involvement of all stakeholders is one of the key points of sustainable development relying equally on environmental, social and economic pillars.

As a result of these processes, there are two globally dominant certification systems for SFMs: The Forest Stewardship Council (FSC) and the Programme for the Endorsement of Forest Certification Schemes (PEFC). Nowadays, around 500 million ha of forest are managed according to both or one of these two standards globally, and over 50,000 companies sell certified products with a chain of custody certificate[24].

Implementation of forest certification in Romania

As these international developments in the area of SFM certification were unfolding, the Romanian forest-based sector was going through significant changes. Before and after the fall of the communist regime in 1989, forest management was performed by the state for all Romanian forests, through 360 state forest districts. Nowadays, after a long process of forest land restitution and significant regulatory and institutional changes, the state owns only 48% of the national forestland (out of the total forest area of Romanian forests of 6.65 mil. ha), and there are more than 150 non-state forest management structures managing non-state forests (Abrudan 2012). While in 1990, all forest industry was state-owned and centrally

[23]www.fsc.org

[24]For more information, see: www.fsc.org and www.pefc.org

planned, today, more than 12,000 companies activating in the forest industry sector are private. The opening of the EU market, but also the growth in Romanian relations with companies from Asia and North America, partly led to a rapid and successful certifying of the forest management and chains of custody (CoC) of Romanian companies. Nowadays, for some organizations, forest management, and CoC certification play an important role in business relations. This is especially relevant for the bioeconomy, which should build on higher value-added products and transparent supply chains. In addition to serving as an additional seal of assurance for good practices, certification can also improve the image of the Romanian forest-based industry whose reputation has been recently tainted by various corruption and illegal logging scandals.

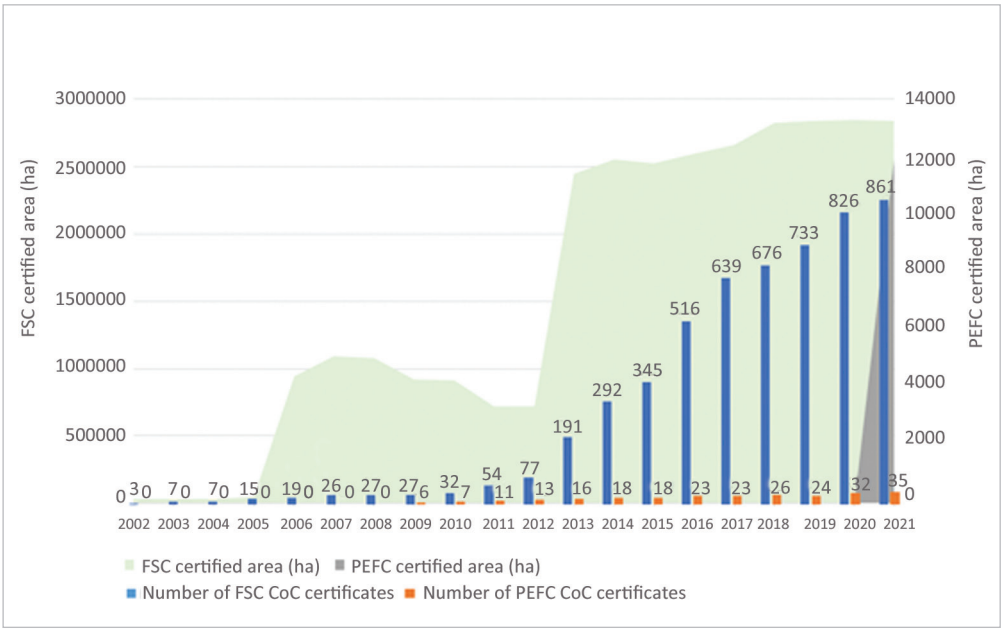

Figure 2.14 Evolution of forest certification in Romania

The first certification scheme adopted by Romanian companies was FSC in 2002, after discussions with FSC had been initiated in 1999-2000 by the Faculty of Silviculture and Forest Engineering from Brașov. Profiting from this first-mover advantage, the FSC gained interest from Romanian companies and the National Forest Administration (NFA) Romsilva. In this context, the discussion on sustainability and forest certification is more related to the FSC scheme than to the PEFC scheme. Nowadays, however, both global certifications are followed in Romania. Both schemes have developed standards at the forest management level and continued with traceability of wood with the chain of custody certification.

The evolution of the certification was a very dynamic process (figure 2.14). From the first attempt in 1999, when the Faculty of Silviculture and Forest Engineering in Brașov initiated the discussions on forest certification with NFA Romsilva, until today, the certification has evolved rapidly from a less trusted initiative to an instrument that can be associated with the

recognition, reputation, and economic development. In 2002, the first FSC certificates were issued for two forest districts (Văratec and Târgu Neamț) in Neamț county. In 2005, the first private forest district received the FSC certificate for forest management. Presently, the FSC certification scheme is the main active scheme for forest management in Romania with more than 2.8 million ha of certified area (Figure 2.14).

According to the global report prepared by FSC Market Info Pack in 2015 (FSC 2015), Romania ranked first in the world between January 2013-January 2015 in terms of increasing numbers of FSC certificates for chain of custody issued by country. Romania has experienced the fastest average annual growth in CoC certificates at over 70% per year. At the forest management level, the country ranks 4th place in the world with an increase of 122% of FSC certified forest area.

Another important milestone for FSC implementation was the accreditation of the Standard Development Group of the National Forest Stewardship Standard by FSC International. This process of FSC National standard development, with adapted indicators for Romanian forest management, was approved in 2017 and came into effect on the 15th April 2019[25]. This process demonstrates the interest in using sustainability indicators that are better adapted to specific Romanian legislation, silvicultural norms, rights of forest workers, as well as community and forest owners' needs.

A newcomer to Romania, the PEFC national office was created in 2016, and also developed its own FM standard. In 2021, around 12,000 ha are recognized to be managed according to PEFC criteria and indicators (Figure 2.14), and the interest in this scheme is increasing. Today, certified products are traded by more than 880 FSC and 32 PEFC certified companies[26]. To date, FSC certification remains the main independent tool for promoting responsible forest management in Romania. There is a constant demand from intermediate and final consumers for FSC products, which is reflected in the demand for certified wood at the forest level. Currently, Romania is following the global trend by increasing the areas certified under one or more independent certification schemes.

The role of forest certification in addressing SFM practices

In certain situations of environmental and economic disputes, the FSC certificate has been used as a support tool by certificate holders to demonstrate compliance with the legislation and as an argument to counter complaints from civil society. In this way, the interest for voluntary certification increased as a response to the concerns raised by NGOs and civil society regarding the legality of timber supply from Romanian forests (Buliga and Nichiforel 2019). A significant number of the beneficiaries of FSC certificates still consider the relationship with stakeholders as one of the main challenges in implementing the requirements of the standard for forest management and in maintaining the FSC certificate (Hălălişan et al. 2018).

The involvement of stakeholders in the implementation of the requirements of the standard is viewed by many forest managers/owners as being intrusive in relation to FSC

[25]www.standardnational.ro

[26]www.fsc.org; www.pefc.org

Principles and Criteria because the concept is new and rather complex. Expectations that exceed the standard's requirements, mainly come from stakeholders with an average to low-level technical knowledge. Situations that trigger non-conformities and create confusion arise when the Indicators are not required by the legislation but are nevertheless mandated by the standards (e.g. ILO supplementary requirements, chemicals, and pesticide lists or social impact assessment). Furthermore, because of the Romanian stringent regulatory framework, the effect of voluntary certification requirements is less about setting higher standards; it rather contributes to better enforcement of the existing legal rules (Buliga and Nichiforel 2019).

Despite this, public consultations continue to play a key role in communicating and implementing standard requirements, both for forest managers/owners and stakeholders. The relationship with stakeholders has slightly improved during the consultation processes. One can therefore observe that the independent certification system has become a platform for discussion and can contribute to the dialogue between administrators, forest owners and stakeholders.

The adoption and implementation of forest certification for the Romanian forest-based sector have an important particularity: FSC and PEFC standards are covered to a large extent by the Romanian forest management planning procedures and specific forest sector regulations. Most of the criteria or indicators have been part of these management plans for decades. The new practices brought by certification schemes are especially related to audits, procedures, or transparency. Since 1954, Romanian forests have been classified according to two main functions: Group I Forests with special protection functions, and Group II Forests with production and protection functions, each group containing many sub-groups. This clear classification is the basis for the identification of High Conservation Value Forests, a concept included in FSC standards.

Regarding forest management, the adoption of forest certification by forest districts was mainly conducted through projects financed by the World Wildwide Fund for Nature (WWF) or IKEA. In the case of the National Forest Administration (NFA) Romsilva, certification was seen as a strategy to prove the performance of management according to international standards. During the different stages of adopting certification, some county branches of NFA Romsilva with less performant management were not taken in consideration for certification because they would have had trouble in maintaining the certificate. Another reason for not adopting the forest certification was the location of forest directorates (e.g.. South of Romania) where the certified products are industrially marketable only to a small extent. Here, the demand for certified products is low since there are only a few certified companies compared with other regions of Romania.

In all cases, the forest districts made efforts to adopt this tool despite the requirements for supplementary documents, as well as additional procedures or resources in terms of time and personnel. The benefits are related to chemicals usage, protective equipment for workers, and management of high conservation value forests. From a social point of view, the most visible changes brought by certification are mainly the improved relations with stakeholders and NGOs (public consultations) as well as increased transparency (Hălălișan et al. 2018).

With regard to the types of non-conformities related to standards and environmental issues, most non-conformities are associated with the absence of documents that require written action for the erosion control, and non-conformities related to minimizing destructive

effects during harvesting and wildlife conservation (Hălălișan et al. 2016). Additionally, non-conformities were identified in relation to the absence of non-chemical pest management methods or the lack of adequate equipment for the administration of chemicals. Other common non-conformities were related to the storage of chemicals and solid or liquid organic waste. The audit teams have also identified non-conformities related to the implementation of protection measures for rare or endangered species. Regarding health and safety issues, most of the non-conformities relate to workers' rights and to the code of practice on health and safety in forestry work (safety equipment) (Hălălișan et al. 2016).

From the companies' perspective, the decision to implement certification schemes was mainly determined by financial gains. Considering the different types of certified companies in Romania, the majority have at least 50% of their products destined for external markets. Hence, the decision to adopt certification was influenced by the need to cater to international clients' requests, maintain existing clients, or open new markets and thus get new clients. Also, some of these companies have already implemented other certification schemes (ISO, OHSAH etc.) and have a good management system with clear procedures. For the internal market, only in some cases, the price premium was achieved, and certified products were sold at a better price than non-certified products. This means that the benefits of certification companies are indirect and can contribute to the medium-term strategy of a company by maintaining the clients or opening new markets. Such market mechanisms could be better promoted in Romania through media awareness campaigns, technical reports, and other informative programs (Hălălișan et al. 2013).

To conclude, we can say that forest certification can be a good tool to prove the performance of forest management and can bring clear financial and market (local, national and international) benefits for forest industry companies. The economic effect of certification on the forestry sector is clearly significant. It becomes even more important in the context of transitioning to a forest-based bioeconomy. Under the conditions described above, certification can be a reliable tool through which one can, on the one hand, transparently ensure the conservation of biodiversity and continuity of sustainability of the forest management act, and on the other hand, increase the amount of biomass used and expand value-added chains to long-lasting wood products.

Summary

Since 2002, Romanian forest management administrations and wood processing companies started to implement voluntary forest certification standards as a response to international trends and increased transparency demands. The efforts were rewarded with improvements in the certified companies' corporate reputation and image, access to (new) international markets, as well as maintenance of existing clients. Voluntary standards, as well as criteria and indicators, have been successfully implemented supporting a long tradition of biodiversity conservation and sustainable forest management. Thus, forest certification can play an important role in the Romanian forest-based sector's transition to the bioeconomy, by providing an additional tool for ensuring sustainable, transparent, and inclusive management practices, while at the same time supporting Romanian companies to access the international timber market.

Take-home messages:

- There are very clear premises showing that Romania's forest management addresses most of the voluntary forest certification standard requirements including multi-functionality, close-to nature forestry and protection of biodiversity;
- The interest in forest certification has been high, proving that the forest sector is open to new trends and opportunities;
- Forest certification has been seen by forest owners, administrators and forest industry as a tool to assure the customers about the sustainability of their business;
- Indicators and criteria under forest certification standards in Romania include most forest management planning and legislation requirements;
- Forest certification must be seen as an opportunity to transparently prove the SFM and to create longer and more innovative supply chains (and to capitalize the forest resources on new markets) in the context of bioeconomy;
- Voluntary forest certification schemes managed to bring together forest owners, social and environmental NGOs, local communities, industry representatives etc. who in most cases, reached a consensus regarding the use of forest resources.

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2.5. Sustainability Criteria for the Use of Biomass as Renewable Energy

Antoanela Costea and Radu Vlad

Introduction – challenges

The world is in a continuous rush to safeguard humankind's future by preserving the planet's resources and reducing greenhouse gas (GHG) emissions, while at the same time striving to meet humanity's constantly growing energy needs. Energy security means now more than supply diversification and resource independence; it also means ensuring access to clean, reliable and affordable energy for electricity, transport, heating and cooling (ELSA 2020). Solutions for increased energy security are in many cases fiercely debated in political and social arenas, as they have a significant impact on both the economy and the environment.

Present climate change debates call for fossil fuel reductions in order to cut greenhouse gas emissions. Political strategies focusing on climate change, bioeconomy, and sustainability in general, indicate that the transition to a sustainable energy future is to be achieved with the help of sustainable, renewable energy sources. Among these sources, biomass can play a major role in the bioenergy sector of the overall bioeconomy. Biomass, from the energy perspective, is defined as the biodegradable fraction of products, waste, and residues of biological origin i.e., from forestry and agriculture, fisheries, and aquaculture, as well as the biodegradable fraction of waste, including industrial and municipal waste of biological origin. In this chapter, "biomass" is understood according to the definition put forth by the European Union Directive on the promotion of the use of energy from renewable sources (recast in 2018 and referred hereinafter EU RED II). Given the motivation of this book, our focus here will be specifically on forest biomass.

Within the green energy agenda, the EU Green Deal plays an essential role as it sets the objective for Member States to become CO_2 neutral. This objective has a direct impact on the supply of biomass (forests and the forest-based sector) as it strives to balance and reconcile critical societal needs, economic development and nature protection under a rapidly changing climate. Romania too faces this challenge in its quest to fulfill international and European strategic engagements of climate change mitigation. With its rich forest biodiversity and wood resources, 2.35 billion cubic meters on standing wood and carbon stock of 21.4 thousand kt CO_2 eq. stored in its forest carbon pool (National Forest Inventory, National Forestry Accounting Plan, 2019), the Romanian forest-based sector contributes 3.5% to the GDP (PricewaterhouseCoopers 2016). Furthermore, millions of households depend on forest wood for energy and heating. All these aspects need to be considered when discussing the opportunities and challenges related to bioenergy use in Romania.

Forest biomass-to-energy pathways

Strategic framework

Looking at the national figures, according to its fifth progress reporting for 2017-2018 under article 22 of the renewable directive (version before 2018 recast), Romania has very few

contributions of solid biomass in installed capacity for gross electricity generation, while for the energy in the heating and cooling sector (final energy consumption), the solid biomass accounts for 98.7 % of the total sector share in 2018 (which represented 58.2 % of the total renewable energy sources – RES), 88.3 % of this consisting of biomass used in households. These figures remained roughly the same during the following years (Bio Screen CEE 2021).

The National Energy Strategy version 2020-2030 with the perspective of 2050, identifies firewood as the main form of biomass-to-energy, mentioning that it is burned in low efficiency stoves. The Strategy underlines that the data on the production of solid biomass bears a high degree of uncertainty – about 20% – the central estimate being 41 TWh in 2018 (ca. 14.45 mil tones of wood or ca. 18 mil cubic meters). At the same time, the Romania Forest Status Report for 2018 specifies that the total quantity of harvested wood amounted 19.46 mil cubic meter, out of which only 5.55 mil cubic meters was "wood fuel".

These **data need deeper insight** (i.e. statistical data collection methodologies both on energy and forestry, along with aligned definitions) due to their inconsistencies (Popa et al. 2020).

The National Energy and Climate Plan, approved in October 2021, highlights the need for solid biomass (mainly firewood and agricultural waste) compliance with sustainability criteria (as RED II already foresees them), while estimating an increase of RES in the heating and cooling sector, based especially on the solid biomass availability. However, the plan acknowledges the uncertainties regarding the RES allocation of certain resources, such as firewood, and the lack of clear statistics on the real potential of biomass.

The National Recovery and Resilience Plan of Romania has included, under the forestry sector reform, the need to develop and approve a new Forest Strategy (by the third quarter of 2022), which among other important measures, shall **set out sustainability criteria for forest biomass for energy use**. Moreover, under the energy reform on increasing competitiveness and decarbonization of the heating-cooling sector, it stipulates the diversification of the energy mix in heating and cooling away from forest biomass (with an indicative timeline for completion by the fourth quarter of 2023). The main reason behind this reform milestone is the poor air quality generated by the domestic combustion of coal and wood: "*Poor air quality in Romania has a significant impact on human health in the country (...) steps should also be taken to reduce and control air pollution from biomass, (...) the Plan provides evidence that air pollution will be significantly reduced when using gaseous fuels from a smart grid rather than using biomass and coal in old stoves*" (Commission Staff Working Document Analysis of the recovery and resilience plan of Romania 2021).

During the last two years, a new EU Biodiversity Strategy and new EU Forest Strategy were approved, which acknowledge the crucial role of forest ecosystems for preserving biodiversity and for capturing carbon from the atmosphere and thus storing significant carbon stocks. The EU Taxonomy Regulation and Delegated Act and the Fit to 55 packages also strive for a more climate-friendly approach to forest management and wood usage. Needless to say, our national strategic directions also need to be enshrined into this bigger framework of transnational, European efforts of tackling climate change and reducing carbon emissions.

Data reliance

Among the above-mentioned challenges were the data inconsistency related to harvesting, timber stocks (and related carbon pools), and energy use. A closer look at the approaches for

gathering this data sheds additional light on this challenge. When it comes to wood used for energy (mainly firewood), the National Institute of Statistics collects two sets of data:

- Energy data, which refers to forest biomass-to-energy as "fuelwood (including biomass)", defined as: " (…) *organic, non-fossil materials of biological origin that can be used as fuel for the production of heat or electricity. This category includes charcoal (solid residue resulting from destructive distillation and pyrolysis of wood and other plant materials), special energy crops (poplar, willow, etc.), a multitude of wood materials generated by industrial processes (especially the wood/paper industry), or which come directly from forestry or agricultural activities (firewood, wood chips, wood pellets, tree bark, sawdust, chips, black lye, etc.) and waste such as straw, rice husks, walnut shells, poultry manure, grape yeast, etc. The technology preferably used to exploit this solid waste is combustion*"; it includes also the quantities collected by households by their own efforts (Energy balance and energy equipment structure, NIS 2019).
- Forestry data, with its own specific terminology and definition for "wood fuel" as being: *"wood volume meant for heating, food preparation and product drying or dehydration; wood volume meant to produce charcoal by pit carbonization*" (Forestry database, NIS).

These two sets of definitions for wood used for energy production and their collection methodology are partly responsible for the data inconsistencies related to bioenergy use. Aside from these definitional inconsistencies, other factors come into play. Firstly, the figure of 3.5 mil households using firewood is outdated, is being used as a reference since 2009. Secondly, the collection methodology for households heating does not provide overall disaggregated data for firewood, wood waste, agricultural waste, but instead lumps them all under one indicator. Thirdly, the data does not include information on public institutional buildings (which also use firewood), nor for industrial operators which use firewood for heating plants or cogeneration (the legal framework stipulates those industrial operators who use firewood do not receive green certificates for electricity production). Lastly, there is also a lack of clear data for agricultural waste (its potential is simply being estimated in the National Energy and Climate Plan between 21.5 and 35.8 mil tones). These are some of the main reasons behind the data inconsistencies that consistently show up in various sector strategic documents related to energy and forestry (Bio Screen CEE 2021).

Sustainability and criteria for wood bioenergy

To have a minimum sustainability cover for biomass-to-energy, RED II established a set of criteria to minimize the risk of using forest biomass from unsustainable production (i.e. legality of harvesting operations, long-term production capacity, forest regeneration, soil and biodiversity protection), and for land with high-carbon stocks in relation with LULUCF and ILUC. Furthermore, RED II includes greenhouse gas emissions saving criteria. For Romania, we cannot find specific law provisions transposing those criteria, yet, there are several laws that are in line with the sustainability criteria laid down by RED II. However, as in many other cases, the existence of legal provisions is not the main challenge, but their monitoring and countrywide law enforcement.

Although RED II lets Member States establish additional criteria for biomass fuels, as they consider necessary, the envisaged revision of the directive pushes for reinforcing the criteria in

a targeted way in light of the increased climate and biodiversity ambitions put forth by the EU Green Deal. In this context, one of Romania's quests is to further develop sustainability criteria that also cover the social dimension of forest biomass used for household heating. The main reason behind this is the increased demand for forest biomass-to-energy.

Moreover, Member States shall ensure, according to RED II, that their national policies and their support schemes are designed with due regard to the **principles of the waste hierarchy** established by the Directive 2008/98/EC and **circular economy principles** that aim to avoid undue distortive effects on the raw material markets. On the waste hierarchy, the European Court ruled that "*the support granted by the Member States for renewable energy sources should be consistent with other European Union objectives, in particular with respect to the waste treatment hierarchy. (...) substances such as the biodegradable fraction of industrial and municipal waste, which are essentially intended either for disposal or for energy recovery, in particular by cogeneration, cannot be regarded as comparable either to wood capable of being used as a raw material or to wood waste, in so far as wood waste can be reused or recycled in the relevant industrial sectors and such treatment may, in the context of that hierarchy, have to be given priority over energy recovery.*" (case C-195/12 - IBV & Cie)

These principles are also in line with **the cascading principle**. It took some time for the cascading principle to be incorporated into European Union policies, but the new EU Forest Strategy for 2030 recognizes that using wood in line with the cascading principle is paramount for building a sustainable and climate-neutral economy. Its aim is, essentially, to pursue the efficient utilization of resources by using residues and recycled materials to extend their total availability and to enable the production of high value-added bio-based products. Improvements in the recovery and utilization of post-consumer wood (waste wood) are necessary to meet **circular economy and resource efficiency objectives**, while industrial residues present a far greater volume with potential for cascading (CASCADES 2016).

Moreover, under the "Fit for 55" package, the European Commission proposes to revise RED II with:

(i) targeted strengthening of the current sustainability criteria by applying the existing land criteria (e.g. no-go areas) for agricultural biomass, but also for forest biomass (including primary, highly diverse forests and peatlands); those strengthened criteria are applied to small-scale biomass-based heat and power installations below a total rated thermal capacity of 5 MW (not only equal or above 20 MW);

(ii) applying the existing GHG saving thresholds for electricity, heating and cooling production from biomass fuels to existing installations (not only new installations);

(iii) further added elements to minimize the negative impact of harvesting on soil quality and biodiversity.

Thus, there are many guiding documents on which Romania may rely upon **when building its own path towards an inclusive, climate-neutral bioeconomy**. However, there are some country specificities that should be taken into account when developing further sustainability criteria:

- Pragmatic rules are needed to ensure that bioenergy used offers **real climate and socio-economic benefits**, with a minimal impact on biodiversity and the livelihoods of forest-dependent local communities.

- Additional (to those set out in the RED II) sustainability criteria should apply to all biomass to energy plants during a commercial activity when claiming green certificates, whether in return for payment or free of charge and regardless of production capacity without any threshold. This would **avoid creating perverse incentives that can lead to market distortion**.
- A precondition related to the use of forest biomass would be that it originates from responsible forest management that follows high sustainability standards and **avoids identified risk areas for illegal logging and forest degradation.** This would also avoid the risk of mixing legally harvested, sustainable timber with products of unknown origin or produced in areas where deforestation or forest degradation has occurred or is occurring.
- Given the national specificity, where most of the local communities in the rural area are dependent on firewood for heating and cooking, the sustainability criteria must include a **robust social component** in a way that the livelihood of local communities dependent on forest resources is not affected by the procurement policies of biomass-to-energy plants.
- Subsidizing biomass to produce energy in industrial installations will significantly impact the wood market, and thus further increase the competition for wood resources. The use of wood as bioenergy needs to be subsidized through green certificates only as a last alternative.
- The competition between the traditional forest-based industry, the needs of local communities, and the bioenergy sector will inevitably increase the pressure on forest ecosystems. Therefore, harvesting must be adequately determined and monitored based on transparent processes. It also needs to consider the provisions of management plans and voluntary commitments for environmental protection (payments for ecosystem services schemes, CAP rural development, forest-environmental measures, strict protection areas, etc.).

Summary/Conclusion

Forest biomass certainly plays an important role in Romania's forest-bioeconomy transition. But ensuring sustainable energy security, that contributes to mitigating national and European CO_2 emissions, needs to be achieved through sustainable forest management practices. These practices must be supported by reliable data and transparent monitoring. A series of European and national policy frameworks, coupled with the RED II sustainability criteria, may help us achieve this. However, these frameworks and criteria need to be adapted and contextualized to national and local realities. Adopting the cascade use principle and circular economy approaches will help prolong the long lifecycle-use of timber, as well as add value to wood products. If orchestrated tactfully, all these policies and sustainability criteria will help put the Romanian forest-based sector on its path towards building an inclusive, climate-neutral bioeconomy.

Take-home messages:

- Romania needs to ensure that the wood used remains within the sustainability limits, while ensuring legality of value chains, forest carbon storage capacity and delivering on biodiversity and livelihoods of local communities.
- When designing policies for energy, policymakers need to align national directions to the EU principles and goals, while taking into consideration the environmental and social realities.
- Bold yet are needed thoughtful policies to thoughtfully manage this climate neutral transition with redundancy.

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EXPERT INSIGHTS: Business Models that Can Unlock the Potential of the Romanian Forest-based Sector

Daniel Paul Dima

At the beginning of part two of this book, we have learned that innovation is a central pillar of the transition to the circular bioeconomy (see chapters 2.1 and 2.2). We have also learned that innovations may lead to a partial expansion of the forest-based sector, in particular by improving its competitiveness with competing feedstocks. But in terms of competitiveness, Lovrić and Moiseyev (chapter 2.3) point out that Romanian timber exports have generally remained constant, dominated by lower-level added-value wood-based products. Nevertheless, the Romanian forest-based bioeconomy shows signs of specialization towards higher added-value paper products.

In terms of commercial forestry, Romania has a very lucrative wood harvesting and mechanical processing industry, which, together with the furniture sector, contributes 3.5% to the Romanian GDP, directly employing 150,000 workers, and bringing a net plus of 2.5 billion euro to the country's annual trade balance. But is this enough to jumpstart a truly innovative business landscape that will propel the Romanian forest-based sector in the era of bioeconomy?

Channeled properly, and benefitting from upgraded legislation in tune with the legislation of the European Union, part of this financial success could contribute to the creation of an innovative business landscape in the era of bioeconomy.

As a forester and forest business consultant with direct working experience in both Romania and Finland (a country that needs 23 million ha of land to accommodate a similar forest resource as Romania, but much poorer in species diversity), I have been struck by the difference in economic performance between the two countries. Simply put, the Finnish forest and woodworking sector generates six times more value than their counterpart from Romania. Therefore, I am of the opinion that, apart from being the European gem in terms of forest biodiversity, Romania holds a large potential to develop bio-economically, by adding value to both traditional and novel wood-based bioproducts.

If we consider tangible products, there are several economic sectors that are already well developed in Romania, and which could be integrated with the forest-based sector, and benefit from sustainably harvested and processed woody biomass (Figure 2.15). These are:

- **The energy sector**, and its dedicated national strategy and policies, are almost completely ignoring the immense energy potential of the forest biomass that Romania

holds if the thermal and electric energy were to be produced in high-efficiency cogeneration facilities. An estimate made by the company Energy Serv S.R.L. claims that Romanian forests could provide more electricity than a nuclear reactor, and more thermal energy than two nuclear reactors, without depleting the resource.

- **The construction sector** could benefit from using more timber for construction. Construction wood is already well recognized and demanded by foreign markets, from China to the US, from Northern Africa to Western Europe. With a different Government approach regarding the utilization of wood for residential constructions, the highly popular "mass timber" could be successfully implemented in Romania as well. By building residential and industrial projects with Romanian wood in Romanian cities, sustainability could be increased both by fixing more Carbon in long-term products and by avoiding environmentally costly transport of low added-value products overseas. It is a matter of true cost accounting, not yet adopted by mainstream economists, but more and more relevant in the narrative about the intelligent utilization of local resources.
- With two **automotive** global leading companies manufacturing in Romania, and with almost one car per capita, Romania is both a strong producer and a user of vehicles. The European efforts to reduce engine emissions can be supported by a new generation of plant-based biofuels and bio-lubricants; therefore, forests could play a role in this respect as well. This business model could make eco-economic sense, especially when using wood waste resulting from the sawmilling industry. As Stern and colleagues mentioned in the opening chapter of this section, wood can also be used in automotive applications and wood also offers interesting solutions for automotive engineering.
- **The textile sector** is generating important employment (175,000 people) and turnover (2% of GDP), similarly to the forestry sector (National Statistics Institute). Currently, Romania imports most of the bio-based fibers it uses in fabrics and garments. The traditional way of producing and processing these synthetic- and cotton-based fibers is very intensive and costly in terms of water consumption, CO_2 emissions, and recycling. There are good examples of more environmentally friendly solutions based on wood-fibers from Scandinavia (Finland, Sweden) and Central Europe (Austria). Romanian companies could learn from them, and implement similar concepts successfully, by using the diverse fiber types available in Romanian natural or planted forests. One major advantage that Romanian companies could benefit from is the proximity to the Western European market, which is ten times faster to reach compared to competitors from the Far East. With ongoing infrastructure development projects in place, and with access to the EU common market, Romania could be well situated in creating a success story from social, economic and environmental standpoints.
- **The pharmaceutical sector** is another important pillar of Romania's economy, contributing 6% to the GDP (National Statistics Institute), following major investments from several top European producers, which export most of the medicines produced in Romania. There is new utilization of woody (micro) crystalline cellulose for the production of new medicines, opening unexplored possibilities to connect the wood processing industry and its waste with one of the largest economic sectors, not only in Romania but in the world.

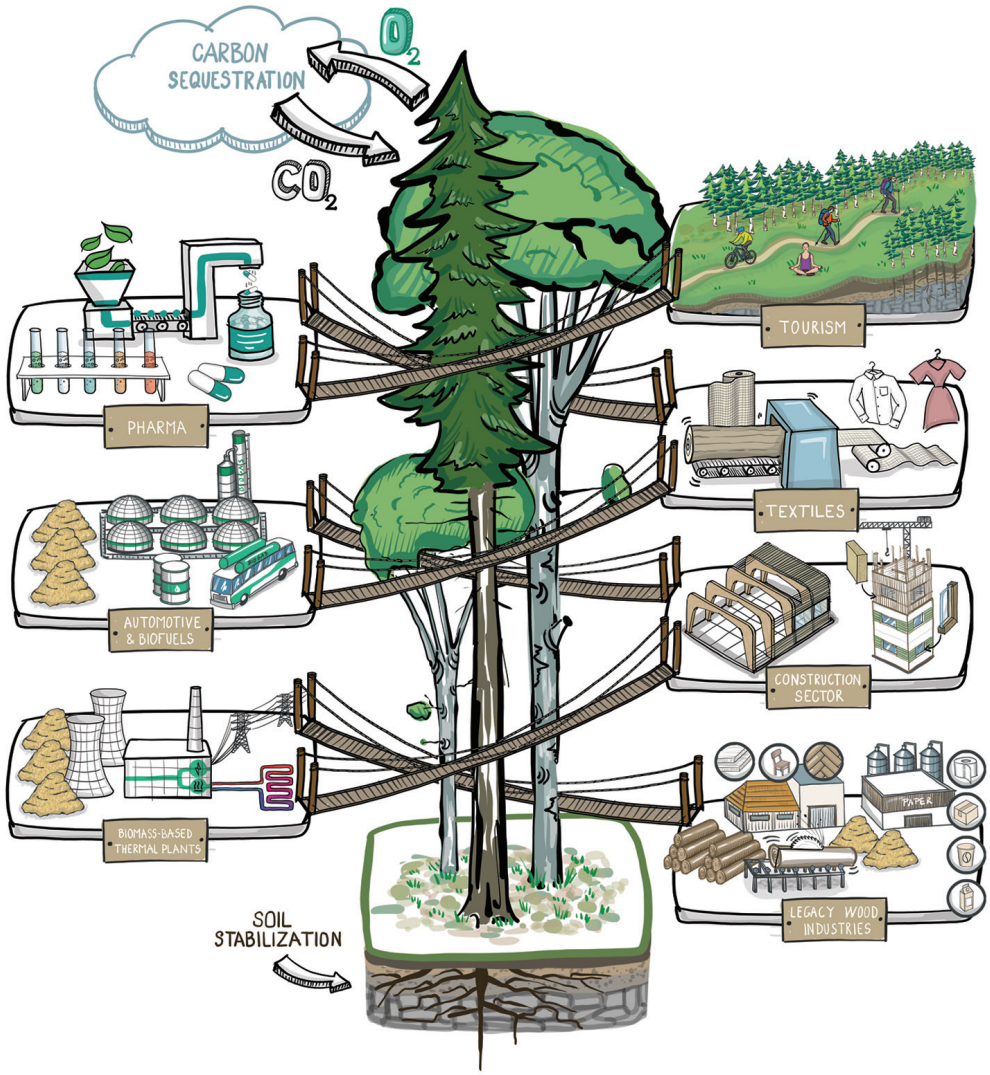


Figure 2.15 Synergistic model of forest-based bioeconomy

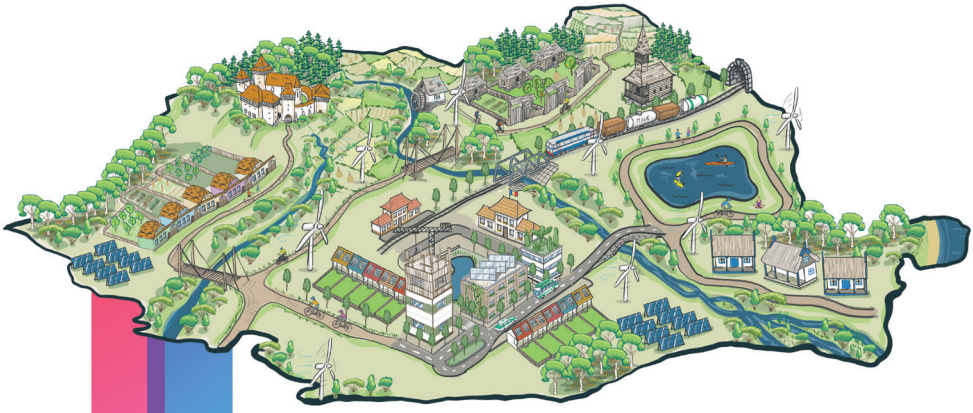
Other successful utilization of wood components can be found in cosmetic products as well as in food for people and feed for animals. These sectors do not use only woody biomass, but also non-wood products, such as forest berries, mushrooms, resins, and tannins – all loaded with natural components which are very attractive for health, wellness and food industry.

There are also a good number of non-tangible and hard-to-monetize benefits that forests provide, from iconic sceneries, tranquility, clean air, flora and fauna, to paths for walking, tracking and biking, to name a few. These could all contribute to boosting Romania's ecotourism and benefit local (mainly rural) communities, and safeguard biodiversity.

All in all, my personal opinion is that Romanian forests and wood-working sectors could contribute – directly and through integration with other sectors – at least double, if not treble to the country's GDP, compared to what they currently do. What is needed is a change of heart, and a shift from an almost complete focus on mechanical processing to novel and innovative chemical processing of wood, which would generate high value-added products. The idea is not to cannibalize the wood market, jeopardizing existing investments and successfully running businesses, but to complement them with new ones, based on the concept "more from less".

Take-home messages:

- In terms of commercial forestry, Romania has a very lucrative wood harvesting and mechanical processing industry, which, together with the furniture sector, contributes 3.5% to the Romanian GDP.
- Romania holds a large potential to develop bio-economically, by adding value to both traditional and novel wood-based bioproducts.
- There are several economic sectors (the energy-, the construction-, automobile-, textile-, and pharmaceutical- sectors) that are already well developed in Romania, and which could be integrated with the forest-based sector, and benefit from sustainably harvested and processed woody biomass.



PART 3

SOCIETY

POLICY

GOVERNANCE

IMPULSE 3:
Romanian Forest Policy in the EU Context

Filip Aggestam

The European forest sector, including relevant Romanian forest value chains, has an essential role to play in preventing climate change and biodiversity loss while, at the same time, providing a wide range of forest-based products and services, such as being a source for renewable energy and public health, and as part of the wider bioeconomy. These societal functions of forest ecosystems have been widely acknowledged by the European Union (EU), such as in the European Green Deal (EC 2019), despite not having an explicit competence on forests. In other words, from a Romanian perspective, it should be recognized that the Treaty on the Functioning of the EU (TFEU) does not make any provisions for forests or forestry, aside from cork. Instead, the common market rules are applied to wood-based products. This means that the EU can only propose legislation linked to its shared or exclusive competencies as outlined in the TFEU13[27]. For example, the EU has adopted "forest-relevant" legislation, such as the EU Timber Regulation (Regulation, 995/2010) and the Common Agricultural Policy (Regulation, 1305/2013, 1306/2013, 1307/2013, 1308/2013)[28], that affect the forest sectors across all EU Member States, including Romania.

Regardless of the legislative background for EU forests, it is often argued that the Commission does have a "forest policy" as many EU policy instruments directly impact national forest value chains (Aggestam and Giurcă 2021; Aggestam and Pülzl 2020, 2018). The EU has been adopting forest-relevant policies going back as far as the 1960s. Initial efforts to address the forest sector at the EU level were mainly anchored in agricultural policy, such as measures that subsidized investments in forestry. The EU first proposed a Council Resolution in 1978, suggesting the need to better coordinate national forest policies to achieve increased timber production, environmental conservation, and public access to forests for recreation (EC 1978). However, more explicitly, the first EU Forest Strategy was adopted in 1998. It provided general guidelines for an EU forest policy to coordinate other EU forest-relevant policies (EC 1998; Pelli et al. 2012; Aggestam & Pülzl 2020). The second Strategy, which was adopted in 2013, served as an updated and integrative framework that addressed the increasing demands on forests while also tackling changes in societal and policy priorities relevant to the forest sector (EC 2013; Aggestam & Pülzl 2018; Wolfslehner et al. 2019).

[27]See https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:12012E/TXT.

[28]The new CAP covers three regulations, which will apply from 1 January 2023 (Regulation 2021/2115; Regulation 2021/2116; and Regulation 2021/2117).

In contrast to earlier iterations, the third EU Forest Strategy puts forward a range of upcoming actions, such as a future proposal on new EU sustainable forest management (SFM) indicators, thresholds, and ranges; an EU voluntary closer-to-nature forest management certification scheme; the further development of payment for ecosystem services; and a proposal on an EU Forest Observation, reporting and data collection (EC 2021b; EC 2021a). It also recognizes the vital role forest owners have in implementing all the outlined actions, such as educational programmes. However, aside from emphasizing the role of wood in the construction and building sector, the third Strategy does not address the importance of forestry and wood for the economy. For instance, the Strategy primarily considers the substitution benefits from using wood products, not the other wide range wood-producing functions of forests. Furthermore, the lack of other policy domains in the Strategy is evident, focusing mainly on the environment and climate while neglecting other domains highlighted in the European Green Deal, such as the EU's social and growth objectives.

The Strategy recognizes earlier problems, such as the limited funds available to forests through rural development funds. Nevertheless, one of the main objectives of the Strategy remains the re- and afforestation, even accompanied by a roadmap (EC 2021a). The emphasis on re- and afforestation would suggest that the primary tool employed by the Members States will remain afforestation as other types of forestry measures have not been taken up extensively during programming periods (Alliance Environnement et al. 2018), despite past and active efforts by the Commission.

Regarding the level of coherence between the relevant EU policies affecting forestry and forest governance in general, one additional development is the proposal to merge the Standing Forestry Committee and the Working Group on Forest and Nature so that they become "a single expert group". This can be seen as recognition that the forest governance structure needs to be revised at the EU level; however, the proposed changes raise two concerns. First, the proposed merger mainly addresses the environment and does not address the absence of industry in this equation. This is a problem for the new Strategy and reflects earlier criticism. For example, the forest sector plays a vital role within the European bioeconomy, which is not adequately considered in the new Strategy. The second, and perhaps most relevant, is that no proposals are put forward to improve governance and communication between different Commission services. Instead, the proposed changes mainly focus on improving communication between the Member States and relevant ministries (primarily those in charge of the environment and forests). The forest-based sector would have expected solutions for smart policy coordination that can help set balanced, not conflicting, objectives in forest-relevant policies at the EU level. Unfortunately, the new Strategy misses this opportunity, and it is unlikely that the third Strategy will allow coherence between the many EU forest-relevant policies in place (Aggestam and Giurcă 2021).

Other relevant instruments, such as the land-use, land-use change, and forestry (LULUCF) regulation, set out to contribute to the EU's 2030 emission reduction target, including the land-use sector. The Commission is revising the LULUCF regulation once again (Regulation 2018/841'; Commission Delegated Regulation 2021/268'; Decision 529/2013/EU). Also, it is revising the Rural Development Fund, through which the EU's Common Agriculture Policy (CAP) provides financial support to rural areas. This is the main instrument EU countries use to fund forestry measures through national rural development programmes. At present, the rules for rural development spending during 2021-2022 are laid out in the CAP transitional

regulation (Regulation 2020/2220); however, the future CAP legislation is set to begin in 2023. Additional areas that relate directly to the EU forest value chain include the EU's nature legislation (the Birds and Habitats Directives), Farm-to-Fork Strategy, EU LIFE programme, and the Forest Reproductive Material Directive.

In the case of Romania, having joined the EU in 2007, it has been active in implementing the first and second EU Forest Strategy. Specifically, Romania has been involved in implementing the EU Forest Action Plan and, more recently, implementing the Multi-annual Implementation Plan of the second EU Forest Strategy (EC 2015; EC 2006; Pelli et al. 2012; Wolfslehner et al. 2019). These plans outline the respective measures taken by the EU to ensure a coherent approach to forests and the forest-based sector prior to the new Strategy (EC 2021b; EC 2021a).

It should further be noted that the Romanian forest-based sector is affected by many hard (e.g., directives and regulations) and soft (e.g., strategies and action plans) EU policy instruments. For example, the EC has recently rolled out several important policy instruments and regulatory proposals. This includes the updated Bioeconomy Strategy and action plan to develop a sustainable and circular bioeconomy across the EU (EC 2018b; EC 2018a). Furthermore, the Commission adopted the new circular economy action plan in 2020 as one of the main building blocks of the European Green Deal (EC 2020b). In this context, the Romanian forest industries can play an essential role in driving the development of a sustainable circular bioeconomy and using wood as a strategic resource for a green recovery and a sustainable future.

EU policy instruments that are relevant to Romanian forest industries demonstrate, on the one hand, that there are long-standing efforts to address forest-relevant issues at the EU level. Today, these frameworks set ambitious objectives and targets that range from the decarbonization of the building sector to maximizing the potential of carbon storage in forests to compensate for land use and forestry sector emissions by CO_2 removals to financing measures supporting SFM to halt the loss of biodiversity and ecosystem services. However, on the other hand, the wide range of policy domains (e.g., trade, agriculture, and energy) highlight that the forest-based sector is set against a complex and incoherent backdrop of different sectoral perspectives, policy goals, and implementation tools (Aggestam and Giurcă 2021; Aggestam & Pülzl 2018, 2020).

EU forest-relevant policy instruments are furthermore set against national specificities. For example, coming back to the new EU Forest Strategy, the call for an EU Forest Observation may challenge Romania as it does not have a coherent set of indicators for monitoring the forest sector. The same can also be noted for the protection of old-growth forests. While Romania has a significant area of old forests (not necessarily pristine forests) that could be important for conservation, there are disagreements about how Natura 2000 should be implemented in Romania. The same applies to biomass for energy, where more than 3,5 million households in Romania use between 15 and 20 million m^2 of firewood for heating and cooking, annually. This has raised concerns regarding resource use efficiency. The latter point also relates to one of many conflicting policy objectives that ultimately characterize EU forest-relevant policy, such as conservation versus renewable energy targets. These conflicting targets correspond to a more profound governance challenge that cannot be addressed without changing the tools and mechanisms available to implement the Strategy. Even more, if we set aside the legal challenges (e.g., issues surrounding competence), some basic building blocks are missing. For instance, the absence of a definition for what EU "forest policy" should entail for the European Community

makes it challenging to delimit or focus a future Strategy on a few concrete measures or provide a better strategic vision for forests. Also, there is limited understanding of how the EU Member States and the EU's political priorities mix at the national level and whether vertical and horizontal coherence between policy domains and policy instruments can be achieved. This would suggest that simply having a shared agenda on forests is not enough, particularly if the third Strategy wishes to impact the European Community.

Finally, it is of interest to note that Romania is developing a new national forest strategy, set to be finalized and adopted in 2022. While it is too early to say what will go into the Romanian strategy, an initial consultation process indicates both commonalities and differences with the EU vis-à-vis the national vision of the forest sector. Commonalities include the need for afforestation and a better data collection and reporting system, and differences include forest owners' decision rights and biodiversity conservation integration. It will be interesting to see how the Recovery and Resilience Plan of the Romanian Government elaborate a new strategy for the forest sector. The following chapters in this last part of the book will focus on some of the most important aspects related to society, policy and governance that should be considered if Romania's new forest strategy will embrace the bioeconomy narrative.

Take-home messages:

- The Commission does not have one "forest policy", but many EU policy instruments that directly impact national forest value chains.
- The third EU Forest Strategy puts forward a range of upcoming actions, such as a future proposal on new EU sustainable forest management (SFM) indicators, thresholds, and ranges; an EU voluntary closer-to-nature forest management certification scheme; the further development of payment for ecosystem services; and a proposal on an EU Forest Observation, reporting and data collection. It also recognizes the vital role forest owners have in implementing all the outlined actions, such as educational programmes.
- EU forest-relevant policy instruments are set against national specificities. For example, the new EU Forest Strategy calls for an EU Forest Observation may challenge Romania as it does not have a coherent set of indicators for monitoring the forest sector.
- Romania is currently developing a new national forest strategy. This is a unprecedented opportunity to show that the forest industries can play an essential role in driving the development of a sustainable circular bioeconomy.

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3.1. Changing Governance and Policies

Liviu Nichiforel and Laura Bouriaud

Introduction

The implementation of the forest bio-based economy requires coherent policies and governance mechanisms that need to address the trade-offs and the synergies of different sectoral strategies such as the climate change strategy, the biodiversity strategy, the bio-energy strategy and the rural development strategy.

Over the past 30 years, the Romanian forest-based sector has faced important institutional and structural changes as part of the transition from a centralized, communist political system to the market economy. The developments that have affected the forest-based sector during the last three decades (Abrudan et al. 2009; Abrudan 2012; Nichiforel et al. 2015) can be summarized as follows:

- the restitution of forest lands to their previous, pre-1948, owners;
- the institutional separation of the regulatory, control and forest management functions;
- the changes in forest administration and more specifically the establishment of private forest districts;
- the privatization of the wood harvesting and processing sectors;
- the establishment and management of large protected areas as National and Nature Parks and the designation of Natura 2000 sites;
- the transition from a state-centred forest governance framework to a multi-layered governance framework resulting in a diversification of stakeholders and governance mechanisms.

Most of the above developments are still undergoing institutional transition, as for example: the restitution of ownership; the reorganization and consolidation of legislation and regulatory authority; the re-organization of the state forest administration; the organization and administration of natural protected areas; and the diversification of policy instruments as an alternative to the highly regulated legal framework.

Despite the relevant changes in the ownership and the organizational framework of the forest-based sector, the policy framework is still represented mainly by regulatory means, Romania having one of the most regulated forest management systems in Europe (Nichiforel et al. 2020). Nevertheless, the economic and political "shocks" that have affected the country since the 1990s have a substantial impact on the forest sector, especially in regard to the lack of law enforcement (Popa et al. 2019) and the exposure to illegal logging (Bouriaud and Marzano 2014). The consequence is that social perceptions on forest management in Romania are highly negative as confirmed by a recent national survey indicating that 53% of Romanians consider that all types of forest logging should be prohibited (IRES 2020). Thus, the gap between the perceptions of the general public on the outcomes of forest management and the desired policy goals is currently larger than ever.

In this context, the current governance challenge is to make use of the forest-based bioeconomy, as a new policy narrative, to build a coherent national forest strategy that can

be socially inclusive and responsive to existing bottlenecks. The strategy needs to take into account both the size and the quality of Romanian forests in order to balance the requirements coming from the 2020 EU Biodiversity strategy for increased forest protection with the biomass needs for the circular bioeconomy.

Changing governance frameworks – making use of diversity

Although the forest policy framework has remained highly regulatory and largely based on command-and-control instruments, the constellation of stakeholders and the resulting governance mechanisms have diversified especially in the last decade.

In the year 1990, at the beginning of the transition period, the forest sector was organized according to a communist structure based on a clear differentiation between three sectors: 1) state forest administration 2) state harvesting and primary wood processing companies and 3) state wood industrialization companies. All these state structures functioned as part of a centralized planning system that decided how the resources should be transferred among them. The transition to the market economy meant a change both in the diversification of stakeholders and in new governance mechanisms.

The increased constellation of stakeholders is related to the forest land restitution, the privatization of the wood harvesting and processing industry, the changes in the administrative and control functions of the state and the increased role of NGOs in forest policy formulation and implementation.

The process of forest land restitution started in 1991 and was implemented through three main restitution laws (Law no. 18/1991, Law no. 1/2000 and Law no. 247/2005). The resulting ownership changes brought important challenges to the forest and environmental governance (see also the chapter 3.2 on Forest ownership). Consequently, state owned forests are currently representing 48% of the forest area. State forests are managed by the National Forest Administration - Romsilva. Non-state forest owners are represented by public municipalities (16%), private forests belonging to individuals, juridical persons and municipalities (24%), and common forests or forest communities (12%). Especially large forest estates have been of interest to private investors and financial funds. Thus, forest investment companies are an important ownership group.

Despite the forest restitution process, the administration of forests by an authorized forest district (*ocol silvic*) remained a legal obligation for the private forest owners. Major changes in forest administrations started with the establishment in 2002, of the first private forest district as an administrative entity responsible for the management of a local community forest. These new structures can perform mandatory forest administration services for municipal and private forests. Currently, 115 private forest districts are affiliated to an umbrella association (The Association of Forest Administrators - AAP) established in 2005.

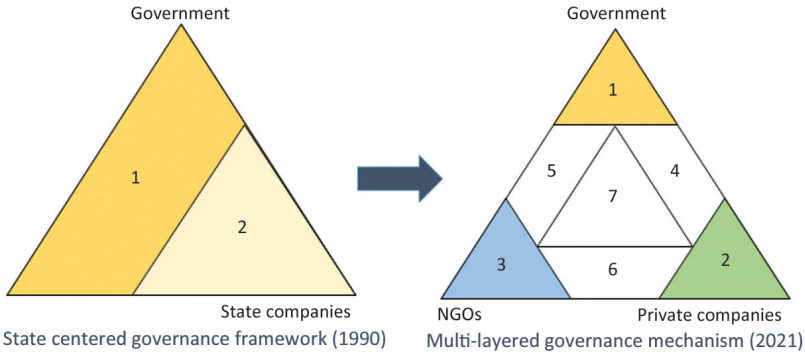
The privatization of the wood harvesting and processing sector started in 1994 mainly by combining the manager-employee buyouts method for small and medium-sized enterprises (employees and the general public were invited to buy shares of the state companies) with open auctions for large companies (Ioras and Abrudan 2006). Currently, slightly more than 4000 private companies operate in the wood harvesting sector and are represented by the Romanian Foresters Association- ASFOR. The forest industry is also fully privatized. Furniture companies are represented in the political process by their umbrella association – Association of Furniture Producers- APMR, but there are also other stakeholders representing forest industry interests

(e.g. Asociația AIL-Prolemn, ARBIO). The wood processing sector has also attracted large foreign investors that play a crucial role on national and international markets.

The institutional separation of the control and forest management functions started in 1999 when Forest Inspectorates were established to monitor and support compliance with the forest regime in private and state forests. Important changes in their organization and territorial representation occurred since then (e.g. in 2001, 2004, 2005, 2021) and recently the National Forest Guard was established with the role to coordinate the activity of nine territorial branches.

NGOs were nonexistent during the communist regime but at the beginning of the transition period, one of the first NGOs to be re-established was the professional association of forest practitioners *Progresul Silvic* which aimed to continue the activity of the association established in 1886. In 2001, two of the largest international NGOs, World Wildlife Fund for Nature (WWF) and Green Peace opened offices in Romania. They started to become active in forest-related activities, especially in forest conservation and certification issues, and they played an important steering role in the forest NGO movement in Romania. In the last decade, the national and international visibility of NGOs has exponentially increased in areas such as combating illegal logging, logging in natural protected areas, and the protection of pristine forests.

To illustrate the change in governance relations (figure 3.1), we have represented the 7 possibilities of combining the links between state regulations - private sector and civil society (NGOs) in the form of the governance triangle (Abbot and Snidal 2009).



Nº	Modes of governance	Examples from the Romanian forest sector
1	Traditional top-down legal standards	Heavily regulated system – more than 165 legal acts
2	Self regulation	Companies' codes of conducts and acquisition policies (e.g no harvesting in natural parks, timber flows, certified timber)
3	Third-party private regulation	National FSC standard, National PEFC standard, National Risk Assessment etc
4	Standards of firms influenced by states (co-regulation)	Support of forest certification by tax reduction
5	Standards of NGOs influenced by states (co-regulation)	Partnerships between NGOs and state agencies especially regarding illegal logging and primary forests identification etc
6	Joint efforts between firms and NGOs	Protocols with companies e.g for the identification of primary forests, for the implementation of certification standards etc
7	Joint efforts between firms, NGOs and States (transnational regulation)	Due dilligence system should work under this framework – the state sets the legal framework, the companies find the best way to mitigate risks, NGOs are involved in monitoring the system

Figure 3.1 Changing patterns in the governance triangle and examples from the Romanian forest sector

The new constellation of stakeholders and the new socio-economic challenges have resulted in the establishment of various types of governance mechanisms (see some examples in figure 3.1). Despite this diversification, the state has maintained a state-centered governance framework, prioritizing command-and-control instruments and a control-oriented mindset. This is reflected in the large number of normative acts (more than 165 legal acts) that are currently in use to regulate forest management in Romania. The elements of the forest legislative system are the Forest Code (originally from 1881), the implementing acts, and the forest technical norms. After the fall of communism, the Forest Code was revised in 1996 and 2008, and modified by additional laws in 2017, 2018, and 2020. In practice, the forest engineer's regular activities are based on 8 volumes of technical norms, covering all the fields of forest activities, from forest management planning and forest measurement to afforestation and forest harvesting. These technical norms were revised in 2000, but few changes occurred, compared with the changes in the general legislation (ordinances, decisions, and orders). From 2008 onward, a legal digital timber flow system was implemented to control and track the wood provenience and use (SUMAL) which has a new version released at the beginning of 2021. All timber suppliers and timber buyers are requested to record in the system the transactions made along the production chain, the timber not-recorded being considered by definition illegal timber.

Moreover, the new set of stakeholders resulted in new approaches to ensuring sustainable forest management e.g. third-party certification, civil society involvement, or NGO campaigns. The large companies operating in the timber supply chains are more often under special observation by civil society organizations and, in order to prove their sustainable management practices to their customers, they have established voluntary codes of conduct, acquisition policies, or digital traceability tools as part of their due diligence system. Besides having their chain-of-custody externally certified (see also chapter 2.4), there are examples of large companies committed not to use timber from National Parks or to use a transparent reporting system assuring timber traceability. While legal requirements are set at a very high level, the external pressure on companies brought by the certification systems is also important. For example, in 2017, the largest timber processing company in Romania had to face a disassociation process from the Forest Stewardship Council, even though the company claims to obey all the imposed legal requirements (FSC 2016) (see also 2.4). The company agreed to become involved together with FSC in a roadmap process meant to set the additional voluntary conditions that must be fulfilled in order to be re-considered for the certification and at the end of 2021 got re-associated to the certification scheme.

NGOs' involvement in forest and environmental governance provides various examples where civil society representatives identified creative methods and tools for addressing the perceived problems by using incisive communication techniques. Successful political action of an environmental NGO in Romania was the adoption, in 2012, of the law on the protection of forests with primary structures, at the legislative initiative of WWF Romania with the campaign message: "Virgin and Unprotected!" WWF has also been involved in identifying and evaluating over 250,000 hectares of forest, of which 41,000 hectares have been included under conservation (WWF 2018). Greenpeace Romania provided a new report on potential forest areas with primary structures (Biriș 2017). The report is supported by a publicly available GIS database on the location of potential virgin forests and it is the basis of a mobile application for notifying interventions in areas with potential virgin forests. Greenpeace Romania's

involvement in the issue of illegal logging is also done by presenting an annual report on illegalities documented by control institutions. Agent Green is another organization that has become very active, especially in the field of forestry activities in National Parks. The NGO also calls for the mobilization of volunteers for protests, carried out both nationally and internationally. The stated aim of the organization is to completely ban harvesting in national parks. The Natura 2000 Coalition Federation includes 15 NGOs in the field of nature protection, being active in the development of projects and strategies on protected areas, biodiversity conservation and implementation of the Natura 2000 network in Romania. Apart from specific campaigns, these NGOs got involved in forest policy formulation by expressing their strategic visions in assumed public documents (e.g. Coalition N2000 2018). On the other hand, created important tensions with different forest associations, and they are criticized for the distorted way that some NGOs present information to the general public (Palaghianu and Nichiforel 2016).

These examples of new modes of governance reflect a need for deliberative democracy in forest policy processes and the pressure for more participative forest decision-making at the local level. The last few years have seen the establishment of new networks both between local and global actors, as well as between civil society, the market, and the state; these relations are much more intense than was foreseen a few years ago.

The fact that the state maintains a heavily regulated system was a critical factor for implementing new modes of governance to substitute the traditional top-down legal standards. The additional effect of these new governance mechanisms, in the context of a highly regulatory framework, is less about setting higher standards in forest management but about contributing to better enforcement of the existing legal rules. One direct consequence is that forest owners, administrators, and companies operate in a risky business environment where bureaucratic and costly legal procedures are often doubled by additional voluntary requirements. On the other hand, these examples show that, even in a stringent legal system, governance approaches reliant on civil society and market-based mechanisms can be more effective at addressing the legality and sustainability of forest-based supply chains when the reactions of governmental agencies are slow.

Forest policies and regulations – is the change possible?

From a rational-choice perspective, policymaking is based on comprehensive assessments of different options and their related consequences. However, taking into account the limited rationality of human decisions, policymaking occurs often as a difficult compromise within a specific configuration of institutions, interests, and ideas (Sabatier and Jenkins-Smith 1999). Therefore, policy stability relates to the limited ability of legislators to deal with more than a few issues at a time (Jones and Baumgartner 2005), to put order in a complex society (Muller 2000), or to espouse an in-depth understanding of the situation (Lindblom and Braybrooke 1963). So, how can policy change occur? Which are the factors that may lead to a change in the forest policies in Romania? And, is the bioeconomy discourse integrated into the development of a new forest policy?

Policy change can be interpreted as a shift based on exogenous (critical events, major demographic or technological changes) or on endogenous developments (shifts in the societal values, constellation of actors, or knowledge available at a certain moment). There are paradigmatic (radical) changes or incremental (marginal) changes affecting policy goals,

policy strategies, and programs. Most policy decisions involve small changes and a limited degree of understanding of the situation (Lindblom and Braybrooke 1963). The forest policy in Romania is a typical case: policy decisions show up within the same sustainable forest management paradigm, nourished by both sustained yields and multifunctional forestry, whose main pillars remained the same for a long time: compulsory forest administration rule applied irrespective of ownership (*regim silvic*), command-and-control mechanisms, and ecologically-oriented forestry. External perturbations such as the forest land ownership reform, the country's accession to European Union, or Natura 2000 network implementation did not lead to major changes in the forest policies. However, policy failures in several domains (e.g. illegal logging, compensating negative financial effects of forest policies on private ownership, and the technological evolutions) resulted in a continuous tuning of policy instruments and tools for sustainable forest management.

Similar to other public sectors, the forest sector policy contains a coherent series of beliefs about the things that ought to be done (values) and about how they should be done. How things should be done is the cognitive component of the policy paradigm, including also explanations about cause-effect relationships, shared by the main actors within the sector (Capano 2003). A change about the things to be done or about how they should be done in the forest sector needs deliberation, policy learning, compromise, and multiple exchanges amongst the relevant policy actors. As long as the new governance mechanisms are not used to bring more predictability, transparency, accountability, legitimacy, and participatory policymaking, the conditions are not met for policy change. Alternatively, a change in policy needs a certain level of knowledge or a good understanding of the new circumstances requiring policy action (Lindblom and Braybrooke 1963). For instance, forest policy in Romania suffers from neglecting the role of information and it is far from being "knowledge-based". We can exemplify this with the situation of the annual volume harvested in Romanian forests: if a core value of the forest policy is the sustained yield principle, it is astonishing to see how difficult it is to get the right estimation of the harvesting rate and how contradictory the official country reports about the harvesting rate are. The same situation applies to knowledge about firewood use: different sources will provide, for instance, very different figures for the volume used as firewood, some of them representing the equivalent of the officially recorded domestic timber production. Also, we do not have a deep understanding of how things should be done in the forest sector in order to limit the negative effects of climate change on Romanian forests. Another example of the limited knowledge hampering policy-decision is the cause-effect explanation of social phenomena driving the forest sector's negative image.

The current crisis of the forest sector shows that the frames used to produce meaning and order in a fuzzy reality are no more adapted (Muller 2000). Or, as expressed by Drucker in the Theory of the Bussiness (1994: 95): "the root cause of nearly every one of these crises is not that things are being done poorly. It is not even that the wrong things are being done. Indeed, in most cases, the right things are being done—but fruitlessly. What accounts for this apparent paradox? The assumptions on which the organization has been built and is being run no longer fit reality". We suggest, therefore, that a policy change in the Romanian forest sector is only possible if changes in the socio-economic reality (ownership, societal preferences for ecosystem services) but also in ecologic evolution (how climate change will influence forests functional biodiversity and productivity) will be accounted for in decision making. Policy responses need to be adapted to these new realities.

Since forest policy formulation and implementation procedures rely heavily on bureaucracy and regulation, these policy instruments tend to reinforce existing practices and to promote only incremental-type of changes: "the methods by which bureaucrats identify the problems, the alternatives, the criteria on the basis of which the choices are made, are already given, so that innovation is inhibited and the existing arrangements are perpetuated" (Miroiu 2001). Thus, to meet the challenges ahead, a new relationship needs to form between the structures and the actors operating in the sector that will reduce bureaucracy, will enhance knowledge-based policy-making, and will facilitate policy learning and innovation so that societal demands can be reflected in policy responses. To enable this evolution, in particular in the bioeconomy policy field, there is a critical need for a politically-assumed strategic decision on how to use Romanian forest resources and how to regulate access to these resources.

The way forward for a new forest strategy

Romania needs a national forest strategy that sets the base for a successful multi-layered governance approach that involves the inclusion and collaboration of multiple stakeholders in the decision-making process.

The authorities proposed such a strategy during 2014-2017 but it proved to be outdated and it did not receive support. Different program documents proposing strategic actions were drawn up by academia (ASAS, USV), professional organizations (ASFOR), and NGOs (Coalition Natura 2000, WWF, Greenpeace, Agent Green) which outlined these actors' positioning regarding the elaboration of a new forest strategy.

A systematic approach to designing a new forest strategy was carried out between July 2020 and February 2021 by the two main forestry faculties in Romania, Transilvania University of Brasov and Suceava University, under the auspices of the Ministry of Environment, Waters and Forests. The consultation was set up with stakeholders with the goal to identify strategic options for the national forest policy development. The consultation involved 226 stakeholders who engaged in a structured dialogue in order to formulate sound and substantiated positions on forest policy development directions. The results were based on the responses to two successive sets of questionnaires carried out with the stakeholders who identified options available for 1) forest policy guiding principles (64% response rate) and 2) strategic directions for action, specific measures, and objectives (34% response rate). The consultation process also included three webinars on working groups and two public debates on the provided results.

With regard to the guiding principles, the consultation highlighted varying degrees of consensus (Popa et al. 2021). The principles which drew a high consensus among the respondents included: (1) creating a clear, harmonized and efficient forest regulatory framework which is (2) aligned with sectoral policies adjacent to the forest sector, (3) substantiated on robust, scientifically validated and constantly updated data, (4) involves the active, transparent and constructive involvement of stakeholders in substantiating forest policy decisions (5) ensures public access to up-to-date, useful and relevant information. There was also broad agreement on (6) the need to ensure the stability, continuity and expansion of forest ecosystems that (7) support a competitive and viable forest sector. The principles that gave rise to controversy among respondents were connected to contradictory strategic options with reference to (8)

the level of property rights restrictions; (9) the policy instruments to be used to ensure the continuity of ecosystem services and (10) the integration of social needs; (11) the level of representativeness in biodiversity conservation; (12) the prevalence of the obligation of result or of the procedure and (13) the differentiated or undifferentiated management of forests in relation to the form of ownership.

The results of the consultation process show that a transparent and rigorously structured dialogue allows for a positive exchange of views, even when using online consultation, which is also known to be radical in nature.

Summary

Romania has faced important institutional and structural changes as part of the transition to the market economy, involving the restitution of forest ownership, the privatization of the wood and harvesting sector, and the institutional separation of regulatory, control, and forest management functions. The diversification of stakeholders has led to new modes of governance. Yet, these do not substitute the traditional heavily regulated system largely based on command-and-control instruments. Sound forest management principles such as being close to nature-, and low intensity- forest management based on natural regeneration are also reflected in the diversity and stability of the Romanian forest ecosystems. In contrast, management practices are hindered by weak forest governance principles such as the lack of legal coherence; the lack of accountability related to a control-oriented mindset; the weak effectiveness of policy instruments; limited respect for forest owners' property rights, and little transparency and monitoring of the results of the implementation of the regulatory framework.

Take-home messages:

- The Romanian examples of a top-down, highly regulated governance systems with no flexibility of compliance are prone to remain inefficient when addressing the market challenges of the bioeconomy;
- Governance approaches reliant on civil society and market-based mechanisms were successful at addressing some problems of the forest sector when the reactions of governmental agencies were slow or their resources too limited;
- The legacy of the authoritarian state can make the transition to a forest-based bioeconomy difficult as there are still fundamental guiding principles under debate in Romania (e.g. respect for ownership, levels of mandatory provisions of ecosystem services, rules vs. guidelines, etc,);
- Effective dialogue among stakeholders is possible, as it was proven by the evaluation of strategic options carried out in 2020; this process needs to ensure the transparency, accountability, legitimacy and participatory policy making that may finally position Romania on a similar footing with countries with a reformed forest policy system.

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3.2. Forest Ownership and its Challenging Role in the Forest-based Bioeconomy

Liviu Nichiforel

Introduction: Diversity of forest ownership in Europe

At the European level, the diversity of forest ownership has significant implications for the provision of forest biomass and ecosystem services to the bioeconomy (Weiss et al 2017). This diversity is expressed not only in legal forms of ownership, but also in socio-demographic and social characteristics of the owners (Ficko et al. 2019), in their goals and attitudes for forest management (Weiss et al. 2019), and in the policy instruments used to govern forest ownership (Nichiforel and Hujala 2020).

From a legal perspective, forms of ownership are generally differentiated between public and private. At the European level, the distribution between these two forms of ownership is roughly balanced, 53% of the forests being in public ownership (Forest Europe 2020). Nevertheless, important regional differences exist, private ownership being predominant in South-West Europe (76%), North Europe (70%), and Central West Europe (63%). Public forms of ownership are highly dominant in countries like Belarus, Moldova, Ukraine, Albania, and Turkey (UNECE/FAO, 2020). In particular, countries from Central-East Europe and South-East Europe maintain a higher share of public ownership while private ownership is mostly related to the process of forestland restitution.

Nevertheless, this general distinction between public and private forms of ownership is more diverse when looking at the country-specific definitions for these legal forms (Weiss and Nichiforel 2020). Public forests are defined as forests owned by the state; by administrative units of the public administration; or by institutions or corporations owned by the public administration. Public forests are thus often divided into state, provincial, and municipal forests and classified as such in the national statistics, for example in Estonia, Poland and Romania. Nevertheless, municipal forests in Bulgaria, the Czech Republic, Latvia, and Slovenia are filed under "private" in their national statistics (Weiss et al. 2019).

Private properties are connected to a larger diversity of owners such as individuals, families, communities, private co-operatives, corporations, and other business entities, private religious and educational institutions, pension or investment funds, NGOs, nature conservation associations, and other private institutions. A distinct form of private ownership, contrasting with the public municipal forests owned by the local governmental authorities, is represented by community/common forests which are historically commonly owned by a group of private individuals from the local community. In this case, national differences can also exist in terms of national statistics, for example, for traditional community ownership which is defined as private in Austria and as public in Switzerland (Weiss et al 2019).

This diversity in the legal forms of ownership across European countries is problematic not only because one lacks a unitary statistical interpretation. From a policy perspective, the diversity of forms of ownership poses challenges in the design of appropriate policy instruments aimed to help private and public forest owners to cope with the strategic actions of the forest-based bioeconomy (FBB).

The challenging role of forest ownership in the forest-based bioeconomy

The central role of forest ownership to the bioeconomy is linked to the way in which forest owners are engaged in providing goods and services to the market. Therefore, an important question has to be addressed in the strategies designed to implement the vision for a circular bioeconomy: How does forest ownership affect the forest-based bioeconomy?

Apart from forms of ownership, the following trends are considered to be important challenges in the implementation of the FBB strategy, and which require common efforts from both European and national policies (Weiss et al. 2017):

- **A change in the forest owners' attitudes** and in the social behavior of forest owners is visible, especially in the context of countries from North and Western Europe. The number of forest owners that are actively involved in forest management is decreasing since more forest owners are moving to urban areas, being less interested in the income generated by managed forests because of ecological concerns. These forest owners are often referred to as "absentee" or "non-resident", "urban" or "non-farm/ non-agricultural" forest owners (Weiss et al. 2019). Therefore, in these countries, policy efforts are made to advise forest owners about the advantages of using forest resources in a responsible way in a circular economy. In Romania, this trend is currently mostly related to inactive forest management in the case of small-scale properties that have been overharvested during the 1990s and that need investments in order to be sustainably managed (Scriban et al. 2019).
- An opposite trend is **the increased investments in large forest areas** belonging to industrial companies or to investment funds. These large owners are specific to northern Europe (Sweden and Finland) but their business model has been transferred also to some of the former socialist countries, as is the case for Romania. These companies' approaches draw contrasting reactions, on the one hand, they are seen as introducing efficient management practices and innovation and thus supporting bioeconomy, but on the other hand, they are regarded as monopolizing local markets and creating social tensions (Weiss et al., 2017).
- **The development of a new form of ownership – "the third sector"** represented by philanthropic or charitable non-governmental organizations (NGOs) which have the primary goal of delivering social or environmental benefits rather than of maximizing financial or timber returns (Weiss and Nichiforel 2020). This diversification increases the complexity of the relation between the use of forests and their conservation. This trend is identified also in Romania where NGOs have purchased private lands with the aim to achieve solely biodiversity conservation (e.g. Foundation Conservation Carpathia).
- Across Europe, an **increased fragmentation of forest properties** is observed, which is an important challenge to the efficient application of specific management measures in line with the bioeconomy strategy. Fragmentation normally occurs through the process of inheritance or the selling-off of land. Several countries (e.g. Germany) have made policies to avoid or consolidate land fragmentation through inheritance laws or other land defragmentation or consolidation programs (Nichiforel and Hujala 2020).

Increased investments in larger forest estates and support offered to owners who are focused only on biodiversity conservation are two examples of how markets can address the diversity of goals included in the FBB strategies. Nevertheless, the change in forest owners'

attitudes and the increased fragmentation of forest ownership are important obstacles for the FBB. These patterns and trends in forest ownership identified across Europe need to be acknowledged in the bioeconomy strategies and policies which must address the different forms of ownership by combining policy instruments, including information, financial incentives and regulatory frameworks.

Forest restitution – the institutional change shaking the centralized public system

The major change occurring in the structure of ownership in Europe in the last 30 years is related to forest restitution (i.e. giving back nationalized forest lands to private owners) that took place in most post-socialist countries. Former socialist countries had different approaches to forest land restitution (see Table 3.1).

In Poland, land reform took place in 1994, but forest land was not returned to the ones who owned it when nationalization took place. Many former socialist countries have dealt with forest restitution by means of a single land reform act, usually enforced shortly after the collapse of the communist regime (in 1991 in Bulgaria, Czech Republic, Lithuania, Estonia, Slovenia) even though many amendments were added over time (Nichiforel et al. 2020). Slovakia issued two new laws in a short period of time, in1991 and 1993. In Serbia, the restitution process officially started in 2006 with the Law on the Restitution of Property to Churches and Religious Communities and was followed in 2011 with the law regarding property restitution to physical persons.

Table 3.1. Changes in forest ownership in former socialist countries

Country	Ownership prior to 1990	Private ownership (%)		Type of forest land restitution
		1990	2015	
Slovenia	Private forest ownership existing to some extent	60.4	76.6	Restitution of private ownership in addition to the area existing during the socialist times
Serbia		50.6	57.4	
Croatia		24.3	28.4	
Bosnia-Herzegovina		18.2	20.4	
Poland		16.6	18.1	No forest land restitutions; the increase is the result of afforestation of agricultural lands
Estonia	No form of private ownership	0	49.0	Integral private forest land restitution in one stage
Lithuania		0	39.7	
Czech Republic		0	23.5	
Romania		0	35.6	Integral private forest land restitution in multiple stages
Slovakia		0	37.8	
Bulgaria		0	12.4	

Source: compiled by the author based on the data for forest ownership from UNECE Database (https://w3.unece.org/PXWeb/en). Current national statistics data may provide different values.

In comparison to other former socialist countries, Romanian land reform took place gradually and was implemented by three mainland reform laws. The rationale put forward during political debates oscillated between the need for restitution as moral compensation (mainly in

the right-wing coalition programs) and the need to preserve the forest as a public good (mainly in the left-wing coalition programs). Land privatization was an important element in political campaigns prior to the elections of 1996, 2000, and 2004 (Bouriaud and Marzano 2014).

Before the Second World War, the ownership structure in Romania was characterized by an approximately equal share between state forests (29,9%), forests of municipalities and community forests (28%), forests of churches and other moral entities (20%), and private forests of individuals (23%). Through the Constitution of 1948, all private forests were put under state ownership (see Figure 3.2).

The process of forest land restitution is related to three main restitution laws, complemented with additional laws and governmental decisions:

1. According to the first restitution regulation (Law 18/1991), only individual private pre-1948 owners of forests received one hectare of forest per person. Approximately 353,000 hectares of forest (5,5%) were returned to more than 400,000 individual owners (Nichiforel 2007);
2. The second restitution law (Law no. 1/2000) sets restitution limits at 10 hectares for individuals, all areas for the previously owned forest in case of towns and villages, all area for the forest in case of communities (or maximum 20 hectares per community member) and maximum 30 hectares for churches and schools. Protected forests were exempted from restitution. More than 2 million hectares have been claimed under this law, increasing the share of non-state forest to 35%.
3. The last restitution law (Law no. 247/2005) aims to re-establish the pre-nationalization ownership structure and, according to its provisions, all forest (including protected areas) should be restituted to the former owners irrespective of size, location, and ownership type.

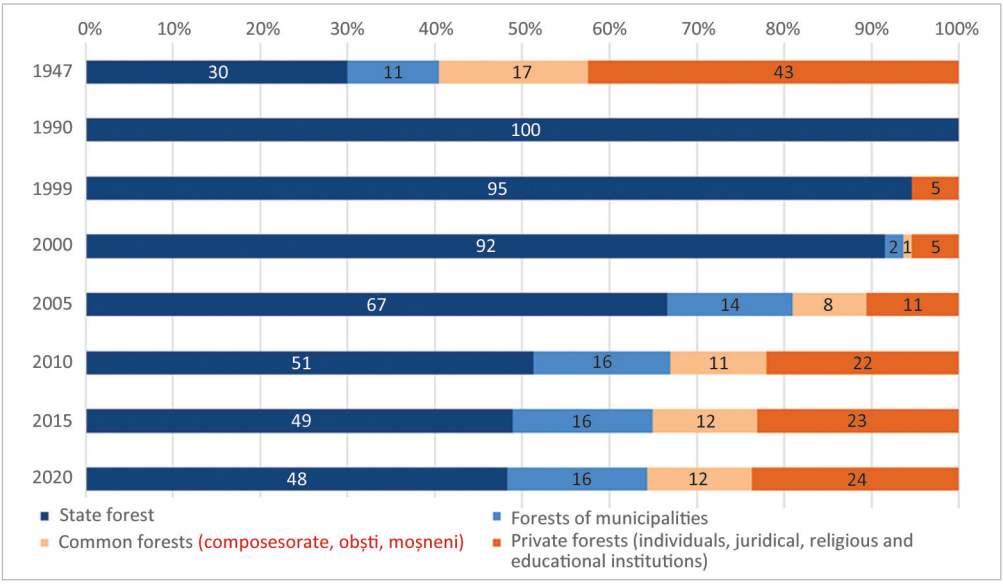

Figure 3.2 Restitution of forest land in Romania

Data sources: for year 1948, data are from Giurescu (1976), for period 1990-2020, data are from annual official reports from the ministry responsible for forests.

Consequently, the changes in the ownership structure in the last 30 years brought important challenges to the forest and environmental governance. Due to forest land restitution, Romanian forestry moved from a heavily centralized sector to a multilayer type of governance, with more actors playing different and even conflicting roles (Dragoi and Toza 2019).

Current forest ownership structure

According to the Romanian Forestry Code, the following classification applies for defining forest ownership in Romania:

Public ownership

A1. State-owned forests, managed by National Forest Administration Romsilva.

A2. Municipal forests i.e., forests owned by local administrative units represented by communes, municipalities, cities, and towns.

Private ownership

B1. Private ownership of individuals and juridical entities, that integrate:

B1.1. Individual owners – i.e. forest owned by individuals and families.

B1.2. Community forests: *composesorates* (obsti) and other community forests. *Composesorate* is an undivided group ownership association within which owners could not physically locate their individual forest land, however, they can demonstrate with documents that they own the forest in common. Owners receive every year dividends according to the land enclosed in the association.

B1.3. Other institutions: Churches and monasteries; associations and foundations; other juridical entities.

B2. Private forests of local administrative units (municipalities), mainly resulting from the afforestation of pasture lands.

Providing exact figures on the forest ownership structure in Romania is difficult as the restitution process is ongoing, and consequently, slightly different figures are presented in different official reports. Nevertheless, in the last years, the changes in ownership patterns determined by forest restitution have slowed down and the general distribution on ownership forms has stabilized (see Figure 3.3). At the end of 2019, the public forests belonging to the state represented 48,3%, while 16% were public forests belonging to the municipalities. Private forests belonging to individuals, juridical persons, and municipalities represent 24,1%, while 11,6% are common forests (MMAP 2019).

Regarding the number of owners and the average size of forest ownership, the data need to be treated with caution as there is no official statistics currently. According to governmental data from 2012, 1,399 municipalities own forests with an average size for municipal forests of 700 hectares, while for common forests the average size was 403 hectares corresponding to 1,845 common entities.

For the private forests of individuals and legal entities, the data from 2012 provide a contradictory ownership structure:

- About 41% of the private forests are smaller than 10 hectares and they belong to 99% of the private forest owners (assessed by the official figure at 346,000 owners);
- About 40% of the private forests are larger than 1000 hectares but they represent only about 0.02% of the forest owners.

While this dual structure is likely to be similar today, the number of forest owners and the average size of private properties are still ambiguous. The main reason is that the transfer of forest property to the heirs is seldom done by using the official cadastre and, in reality, the number of private owners is much larger and the average size of the property is smaller. At the same time, official reports have estimated that in 2012 almost 0,5 million hectares of forests were under legal disputes and unclear ownership (National Court of Accounts, 2013).

In contrast to the fragmentation of property through inheritance, relevant changes in the structure of private ownership occurred as part of subsequent transactions between private forest owners. Large forest estates, in particular, have been of interest to private investors and financial funds. Nevertheless, private forests belonging to industrial companies and investment funds currently represent no more than 3% of the total forest area.

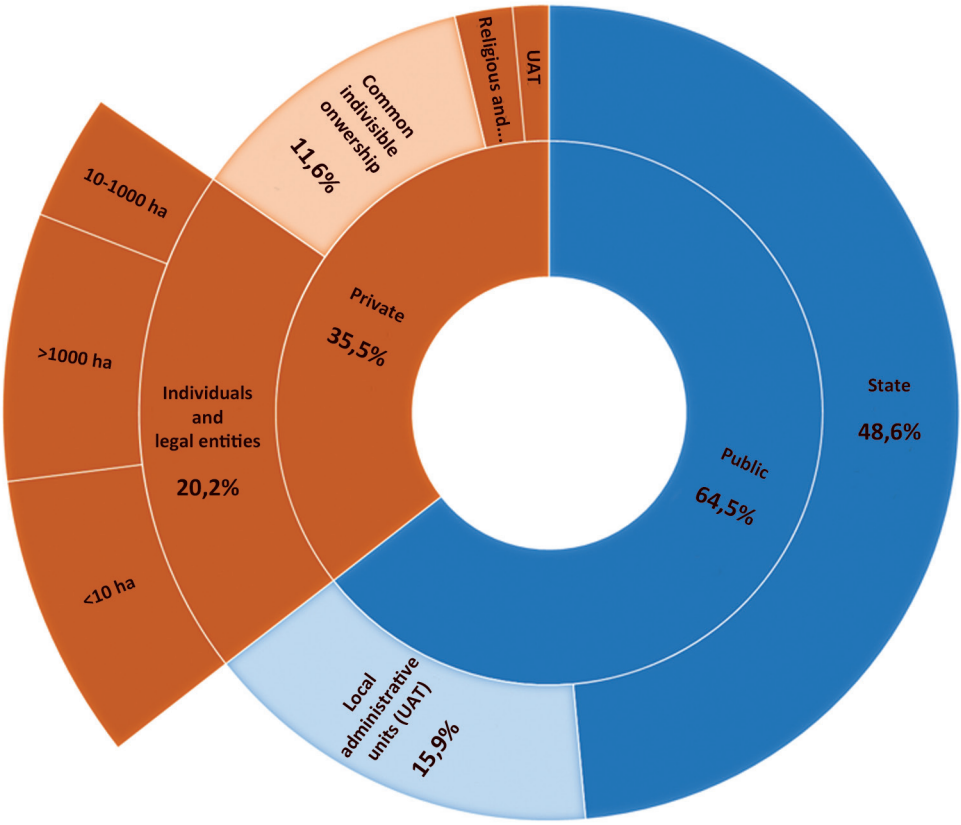

Figure 3.3 Current forest ownership structure in Romania

Challenges for Romanian forest owners in the FBB context

The restitution process has been described as "confusing" and "without vision" (National Court of Accounts, 2013) leading to opportunities for short-term profits (Bouriaud 2005) and to many forest areas being under unclear ownership and under legal disputes (National Court

of Accounts 2013). The restitution process had serious consequences for the stability of forest ecosystems (Griffits et al. 2012), and it generated social conflicts as well as a negative view on forest ownership among some politicians and forest managers from state forest administration (Dorondel 2009; Irimie and Essmann 2009). On the other hand, forest restitution brought important benefits for the political system (Bouriaud and Marzano 2014) and for the unruly local coalitions of timber barons (Vasile 2020), being an important argument in influencing the results of the political elections of 2000 and 2004 (Scriban et al. 2019).

The overall negative view that society has on private forest ownership is an important challenge that needs to be addressed in order to get forest owners involved in developing an FBB strategy. The validity of the restitution process was questioned from the beginning, especially by members of the public forest administration which was perceived as the only choice for sustainable forest management (Irimie and Essmann 2009). The rationale of the first restitution law which limited the private forest estates to a maximum of 1 hectare was that this approach "will save the rest of the former private forests" (Giurgiu 2010). While blaming their poor socio-economic conditions and the insecurity of their ownership status, forest owners made immediate profits from their forests, almost half of the first privatized forest land being clear-felled or over-harvested, in a short period of time (Nichiforel 2007). Even in the second decade after the change of the communist system, the president in power was of the opinion that private forest owners cannot be trusted with the restituted forests and that property is a "trifle" (Dorondel 2009). It is worth mentioning that most allegations made by the state forest administration against private forest ownership, in the initial phase of the forest restitution process, have recently backfired against the forest administration system; both public and private management entities are accused by NGOs, mass media and civil society of illegal activities and environmental damages (Palaghianu and Nichiforel 2016).

The management of private forests provides contrasting approaches which are generally linked to the contradictory structure of private ownership which is divided between small-scale forests and large-scale estates.

Important disturbances in private forests are identified especially for small-scale properties. Small-scale forest owners are, de jure, required to obey strict regulations of forest management including the signing of mandatory contracts for forestry services. The highly restrictive legal framework (Nichiforel et al. 2018) involves high bureaucratic and administrative costs which hinder the economic viability of small-scale forest management and which often cause forest owners to use the forest resource beyond the legal requirements. The forest restituted by Law 18/1991 and the areas with unclear ownership has been largely affected by anthropic disturbances between 1991 and 2002, while those restituted by Law 1/2000 have been affected at a much lower rate between 2002 and 2007 (Scriban et al. 2019). In the case of many small-scale properties, the field inventory shows that forests have been managed using a "cut and leave" approach. This means that, after the heavy cuts from the 1990s, these forests were left to natural succession of vegetation with some disruptive interventions for firewood provision (Scriban et al. 2019). This inactive or disruptive management does not comply with the requirements of the existing silvicultural norms that would entail interventions with tending or with artificial regeneration. The fact that 30 years after the forest restitution, the forest policy system has not adapted its technical norms to the reality of small-scale forest management nor has created financial instruments for the involvement of forest owners in forest land restoration is a major obstacle in the process of adopting a FBB strategy.

The management of community forests is described as problematic in some sociological

studies (e.g. Mantescu and Vasile 2009). Using case studies from Vrancea region, Vasile (2019, 2000) describes the unruly coalitions formed around community forests presented as an elite group of timber barons, local entrepreneurs, loggers, and foresters who control the community forests and accumulate power and capital, revealing the limits of freedom and the internal conflicts within the community. Nevertheless, such attitudes cannot be generalized to all community forests, and it is acknowledged that they were reduced by the implementation of policies against illegal logging starting from 2016.

In contrast to the above, there are many examples of good practice in the private management of forest estates belonging to community forests, municipalities, companies, and investment funds (Nichiforel et al. 2015). For example, practices such as the digitalization of forest administration to counteract bureaucratic requirements and the use of digital surveillance equipment to ensure forest guarding are often used in private administrative units. Some private forest units have established connections with academia and consultancy companies to adapt their management to legislative challenges and to innovate, even in the context of a rigid regulatory framework. Since most private forest investors are under special observation by civil society organizations, in order to prove their sustainable management practices to their investors and to the public, they often have their forests externally certified for sustainable management. The certification process also ensures a more participatory approach to management practices.

The policy approach to private property remains conflictual and has currently moved from the governance dilemma regarding the restitution process to a governance debate regarding the level of property rights needed to be assigned to private owners. The core idea of the Romanian forest policy system is that forestry activities are strongly regulated and that the policy system should promote the same rules of forest management in the case of both public and private forests. The only exception to this rule occurred in 2015 when a change to the Forest Code allowed owners of estates less than 10 hectares to harvest 5 m^3/year without a forest management plan; instead, they signed a long-term contract with a forest district that undertook the responsibility of applying minimal sustainable forestry. Consequently, a comparative analysis conducted at the European level (Nichiforel et al. 2018) shows that Romanian forest owners need to cope with a highly restrictive legal framework unlike owners from most other European countries who enjoy more decision-making power in forest management. One possible explanation for the lack of changes in regulations addressing private forest management in Romania is the fact that forest owners had difficulties forming a strong umbrella association representing their interest in forest policy formulation. The Association of Private Forest Owners was established in 1998 but was plagued by internal conflicts which had weakened its capacity to be a representative actor in the forest policy arena. Nostra Silva, the other national association of forest owners, was more visible in representing the owners' interests in getting back their lands in the context of the three main forest restitution laws.

This situation is slowly changing as Nostra Silva and other local forest associations are becoming more active in representing the voice of forest owners in forest policy formulation. This change could be observed in 2020, in the case of the assessment of stakeholders' perspectives for the design of a new national forest strategy, when the principle of observing the ownership rights had been most highly debated (Popa et al. 2021). There are two conflicting strategic alternatives that are advocated by large groups of stakeholders: (i) that private property is guaranteed by the constitution and therefore, the owners should not be restricted to make use of their forest assets; (ii) that the restrictions on property rights are justified by the general

public interest and thus private forest management should be highly regulated and monitored.

Many of the present challenges could be turned into opportunities if Romanian forest owners would be seen as part of the solution for the FBB and not perceived as a threat. The involvement of forest owners in FBB requires a diversification of the policy instruments, and it must be presented as an alternative to the failures of the current focus on command-and-control mechanisms. Moreover, financial support needs to go beyond a simple compensation for the restrictions imposed by the legal framework. It must instead be a targeted active financial support devoted to changing management practices; it must be used to support digitalization in order to reduce the administrative costs and to create fair access to the new international bio-based markets envisaged in the FBB strategy.

Summary

Changing forest ownership patterns in Romania has been one of the most important institutional changes of the last 30 years. Despite the change of ownership, policy instruments have remained focused on command-and-control tools which failed to address especially the situation of small-scale forest properties, but also, such policy instruments have restricted innovation and efficient forest management for responsible forest owners. The current policy debates regarding granting forest ownership rights show that 30 years after the fall of communism, the Romanian forest policymakers are still puzzled by the diversification of policy approaches addressing the current forest ownership patterns. The bioeconomy strategy must be considered as a vector to support new governance models needed to ensure the financial viability of forest management.

Take-home messages:

- Forest ownership goes beyond a simplistic division into public and private ownership, and the diverse backgrounds and interests of owners need to be acknowledged in both European and national bioeconomy strategies;
- Forest restitution in Romania resulted in a major change in the forest ownership patterns with 52% of the forest area being transferred to non-state forest owners in the last 30 years;
- Romanian private forest owners are perceived, by society at large, in a rather negative way for having undertaken illegal activities and for having caused environmental damages, a perception which was recently extended to the entire forest administration system;
- The property rights of Romanian forest owners are among the most restricted in Europe; these restrictions hinder the financial viability of the forest management for small-scale forest owners;
- The policy debates regarding forest ownership are slowly evolving, moving away from the governance dilemmas related to forest restitution to discussions about new governance models that must give a higher consideration to forest ownership rights.

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3.3 Rural Development and Sustainable Transformations

Andra I. Horcea-Milcu

Introduction: setting the context within multifunctional rural landscapes

This chapter proposes an interdisciplinary understanding of the social aspects of the rural landscapes of Southern Transylvania, developed in seven years of place-based empirical and transdisciplinary research (until 2019) addressing human-nature relationships. Drawing on a large number of interviews and focus groups with residents, farmers and local NGOs, this research generated knowledge by assessing their perceptions and by considering them as both stakeholders and local experts. Although it is not delineated administratively, geographically, Southern Transylvania spans the cities of Braşov, Sibiu and Sighişoara (Fig. 3.4). The county of Sibiu, for example, (Fig. 3.4) had a rural population of approximately 141,000 inhabitants in 2011.

The case study of Southern Transylvania is relevant for the analysis of rural development issues for several reasons. Relatively poor economically, with low to medium intensive agriculture, Southern Transylvania is one of Europe's last biocultural refugia (Barthel et al. 2013) with valuable biological and cultural diversity (Dorresteijn et al. 2015). The heterogeneous character of this landscape stems from a historical co-evolution of social and ecological factors leading to being often conceptualized as a complex of social-ecological systems (Loos et al. 2016). Partly delineated as Natura 2000 sites (an area of approximately 270,000 ha), these human-shaped environments have a multifunctional character, providing multiple amenities beyond food and fodder, such as scenic beauty or a sense of place. These landscapes are the providers of diverse renewable natural resources to be capitalized upon within a bioeconomy driven by rural development. Traditionally characterized by rather direct linkages between resource use and ecological dynamics, most rural livelihoods are at least partly farming-based and persistently reliant on local ecosystem services. For example, firewood is the primary source of household energy for most rural dwellers, as forests in Southern Transylvania occupy roughly 30% of the land-cover, followed by arable land of approximately 20% and surpassed by pastures of 40%.

The region is inhabited by diverse ethnicities: Romanians, Hungarians, Roma, and Saxons, which together with the region's history have created a rich cultural and ethnic diversity, even at the village level. In addition to the Saxon migration, which is specific to Southern Transylvania, the region also underwent other major political, social and economic changes common in the last decades to the whole of Romania. These include the collapse of communism and the accession to the European Union (EU). A direct consequence of the latter was the increasing impact of the EU Common Agricultural Policy (CAP) on the country's farming landscapes (Hartel et al. 2016). The increasing global pressure for a market-dominated economy and the progressive modernization of agriculture has made traditional agricultural practices no longer viable and have decreased the productivity of traditional rural livelihoods while encouraging a strong rural-urban migration. In addition to these, other changes include rural depopulation, inconsistent national tenure changes, and the global markets that have placed the region under a lot of pressure, intensifying the threats of land abandonment or land-use intensification.

Today, these multifunctional landscapes are being altered by poverty, corruption and social exclusion, similar to other rural areas in Romania. By scaling up, Southern Transylvania may be representative of the complex rural development challenges faced by other multifunctional landscapes undergoing similar pressures from the current global economic system. Some of these challenges and associated opportunities are presented in the following section.

Figure 3.4 Map locating the counties of Mureș, Harghita, Sibiu and Brașov in Romania. Southern Transylvania mainly spans the cities of Brașov, Sibiu and Sighișoara. Figure by © Daniela Peukert, after a published version under a Creative Commons Attribution Non-commercial License (CC BY-NC) in Fischer et al. 2019, page 41.

Challenges and opportunities: a diversity of human-nature relationships, aspirations, identities and sustainability initiatives

As is the case with other multifunctional or multicultural landscapes, the rural population relates to the environment in different ways, prioritizing different functions of the environment for their wellbeing and for improving their quality of life. In order to reap the benefits they aspire to, locals envision different ways to manage their landscape based on their capabilities. They may aspire to prosperity and economic growth as well as to maintaining traditions and a balanced lifestyle, to social security and community life, to productive farming and a farming-based lifestyle, or to preserving nature-thriving landscapes.

Members of local communities thus have divergent opinions regarding their ideal vision of human-nature relationships. Some may prefer to revitalize traditions and small-scale farming, while others favor the option of modernization and intensification, and of imprinting contemporary new values on the landscape. Especially areas on the rural-urban fringe are highly pressured by competing land-use interests. Tendencies towards agricultural production,

urbanization, recreation and biodiversity conservation appear to be detrimentally opposed and are difficult to reconcile. The divergent needs, interests and values regarding the nature of the stakeholders inhabiting these spaces lead to conflicts that need to be managed. In this context, managing land for improved equity and sustainability outcomes, through multi-actor governance seems a daunting task. How to represent different parts of society, their connections to, influence, or dependency on nature?

In this challenging context, one opportunity resides in the numerous sustainability initiatives organized around the values of nature, typically led by non-governmental organizations and grassroots movements in Southern Transylvania (Lam 2021). These sustainability initiatives share a nature and a cultural heritage conservation profile and are in favor of maintaining small-scale farming support systems, rural education, community development, and eco-tourism (Figura 3.5). These initiatives are vibrant, locally relevant and leading the way to local transformation (see examples presented in Fischer et al. 2019).

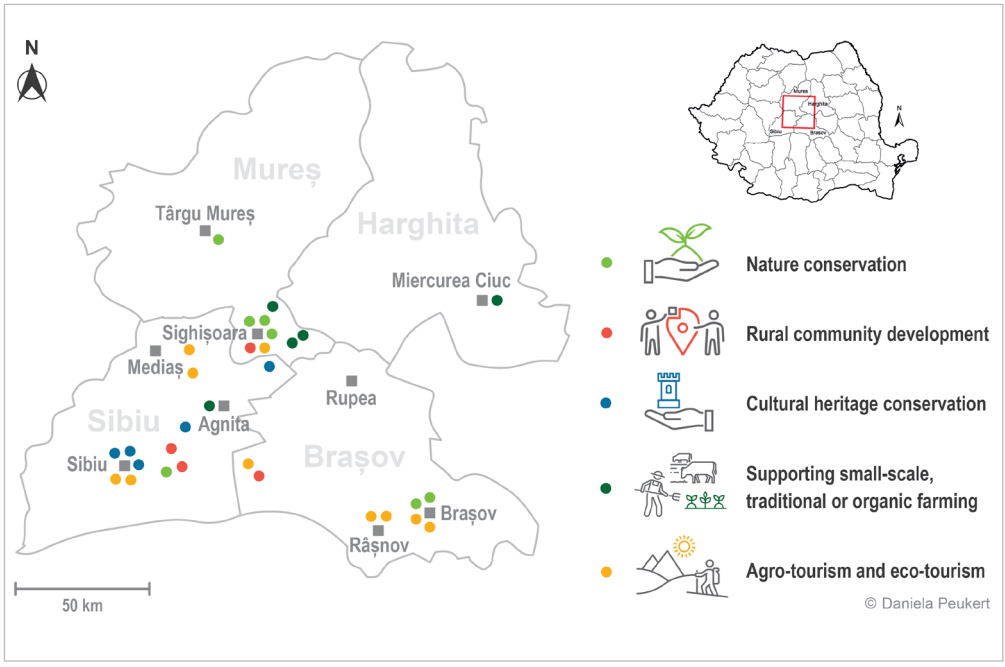

Figure 3.5 Map locating sustainability initiatives in Southern Transylvania. Figure by © Daniela Peukert, published under a Creative Commons Attribution Non-commercial License (CC BY-NC) in Fischer et al. 2019, page 41.

In settings of weak governance, as in post-communist countries or in the Global South, such sustainability initiatives have a significant impact. For example, ADEPT is a local foundation, piloted together with the Pogány-havas association (Harghita), with around 70 small-scale farmers in Târnava Mare leading a results-based agri-environment scheme, in an attempt to promote Transylvania's high nature-value farmland, especially meadows. The scheme is a more flexible alternative to the remuneration schemes proposed by the CAP. It remunerates practical management resulting in good quality hay and the protection of wild

species. Another example relates to the value of wood pastures in Southern Transylvania (based on personal communication[29]).

Local communities in Valea Zălanului together with a local leader established an informal mechanism for protecting the ancient sparse trees found in wood pastures which are traditionally used for grazing. The CAP policy and the interpretation of its measures at the local level allow the cutting of sparse pasture trees in order to ensure eligibility for direct payments. Informal rules set through a spontaneous collaboration among the community, a local leader and a biologist, established a financial compensation for the conservation of ancient wood pastures trees. This financial mechanism was also linked to the development of a business plan on ecotourism that could further provide necessary resources for maintaining compensations to local farmers. Finally, the establishment of the destination management unit of the Transylvanian Highlands is yet another example of a sustainability initiative relying entirely on networking and cooperation among local actors. The formal network emerged organically following the elaboration of management plans for the Natura 2000 sites in Southern Transylvania. During consultations with local actors in 2012, there was consensus towards the promotion of the area as a single unit in view of its common cultural, historical and biogeographical character. The initiative aims to develop an ecotourism infrastructure for the recognition and (re)interpretation of this area in light of its recreational, inspirational and relational values.

The inherent diversity of human-nature relationships in the context of rural development in multifunctional landscapes is therefore a source of both challenges and opportunities. Opportunities reside in existing sustainability initiatives, which with the support of municipalities or regional authorities, can give birth to communities of practice in the domain of forests or landscape stewardship that guide contemporary human-nature relationships towards sustainable pathways (Watkins et al. 2017). These communities of practice are spaces where – through dialogue, deliberation and processes of socialization – community values emerge, become apparent, or are shared in the context of current challenges (Watkins et al. 2017). Additional innovation approaches which involve a diverse civil society, such as the ones proposed in chapter 2.2, are necessary to ensure a degree of experimentation, stabilization, and internalization of community values. How to further navigate the challenges of rural development, with a view to unfolding a circular-bioeconomy transformation for Romania, is addressed in the next sections which explore where to focus rural development interventions and how to intervene.

A vision for rural development: Where to intervene for a sustainability transformation wary of the transformative potential of bioeconomy?

Rural development is typically associated with the so-called "second pillar" of the Common Agricultural Policy (CAP) which simultaneously seeks to improve the quality of life of rural communities, and to enhance the provision of public goods through agri-environment payments. In addition to CAP, another policy component of rural development is the EU-wide network of protected Natura 2000 areas, consisting of Sites of Community Importance (SCI) and of Special Protection Areas (SPA) set up under the Habitats Directive (EC, 1992)

[29]Personal communication with Professor Tibor Hartel, Babeș-Bolyai University, Cluj-Napoca.

and the Birds Directive (EC, 2009) respectively. Such rural development policies are criticized for not considering the broader social realities of the recipients of policy interventions. These deficiencies undermine the social and conservation targets which the rural development policies were initially designed to protect, through the unexpected and poorly understood feedbacks they produce.

In the last decade, research looking at transformative change and transformative adaptation have pushed for another approach to rural development (Bastiaensen et al. 2021; Castro-Arce and Vanclay 2020). Within this body of literature, a recent academic discourse revives the seminal work of Donella Meadows (1999) on the notion of leverage points in order to understand "where to intervene?" to incite societal change. There are four general types of interventions: on the parameters, feedbacks, design, and intent of a system, be it the food system, mobility system, energy system, or the social system of a given country, region, or place (Abson et al. 2017). Interventions at shallow leverage points (e.g., parameters and feedbacks) contribute less effectively to transformation. Of particular interest is the identification of deep leverage points, where interventions would sustain fundamental changes. If bioeconomy is to be part of Romania's forests and societal sustainability transformation, it needs to engage with deep leverage points. Deep leverage points are system properties where interventions can lead to transformation in the system as a whole, as opposed to interventions at shallow leverage points leading to incremental change (Abson et al. 2017). Deep leverage points have been theoretically associated with notions such as intent, paradigms, worldviews, or values.

Empirically, within the research conducted on multifunctional rural landscapes, values appear as particularly relevant deep leverage points (Horcea-Milcu 2015). Held values partly explain some of the changes and at the same time the inertia of the landscapes faced with global pressures. Deeply held values also play a role as mediating factors in the distribution of ecosystem services and their equity implications. Although these values help to maintain a deeper relationship between people and nature, they face the risk of being eroded and degraded by external factors such as large-scale institutional arrangements or state-imposed regulations. There is evidence that one of the best ways to create and maintain a sustainable rural landscape is to tap into the existing local identity, the self-esteem of farmers, their connection to the land, and their intrinsic motivation of making the land worthwhile. Having clarified where rural development interventions need to focus in order to allow for a circular-bioeconomy transformation to unfold, i.e., at deep leverage points, it is necessary to understand how to intervene.

Pathways for rural development: How to intervene for a sustainability transformation wary of the transformative potential of bioeconomy?

How to intervene at deep leverage points and (co-)create transformation pathways towards a sustainable rural development inclusive of the transformative potential of bioeconomy? Drawing on existing literature, and the place-based empirical and transdisciplinary research addressing human-nature relationships in Southern Transylvania, two recurrent notions emerge as pertinent answers to this question: sustainability initiatives, and collaborative approaches such as landscape stewardship.

Taking sustainability initiatives into account

In contexts such as Southern Transylvania, sustainability initiatives represent the building blocks on the transformation pathway towards the desired future. Rural development that

integrates local knowledge and recognizes the efforts to change of local practitioners is more likely to be accepted as a legitimate impulse for societal transformation, it also fosters local empowerment (Lam et al. 2019). The first step of sustainability initiatives, therefore, involves creating a safe space that supports, enables and connects those contributing to a resilient forest bioeconomy for Romania. (Fig. 3.6., P1). Secondly, context-tailored innovation strategies co-designed together with identified change leaders can subsequently complement the missing contributions and accelerate the transformation towards the desired vision (Fig. 3.6, P2). Technocratic solutions should only complement older existing practices which are sometimes more sustainable. As a third step, contextual drivers and barriers can further inform the development of sustainability strategies (Fig. 3.6. P3). Fostering conditions for social learning can support the continuation of these iterative steps (Fig. 3.6., P1-3). One potential pitfall of this approach is the mismatch between the local level where sustainability initiatives are active and the regional and national levels where policies are enacted. Boundary organizations that balance between community and individual agencies, on the one hand, and top-down interventions, on the other hand, may tackle this mismatch.

In the case of Southern Transylvania, there are numerous contributions of sustainability initiatives leading to transformation at the local level based on a commonly agreed-upon vision for this region's future (see Fig. 3.5., Fischer et al. 2019). This normative vision and subsequent narrative called *Balance Brings Beauty* were co-generated and validated through a process guided by academic research (Hanspach et al. 2014). The approach of counting local sustainability initiatives has been a subject of critique because the uptake and subsequent upscaling of similar sustainability initiatives is strongly dependent on factors such as leadership, social capital, and community spirit. Endorsing an action-oriented, and practice-oriented approach by sustainability science and by sustainability researchers alike, can contribute to the development of the above-mentioned factors.

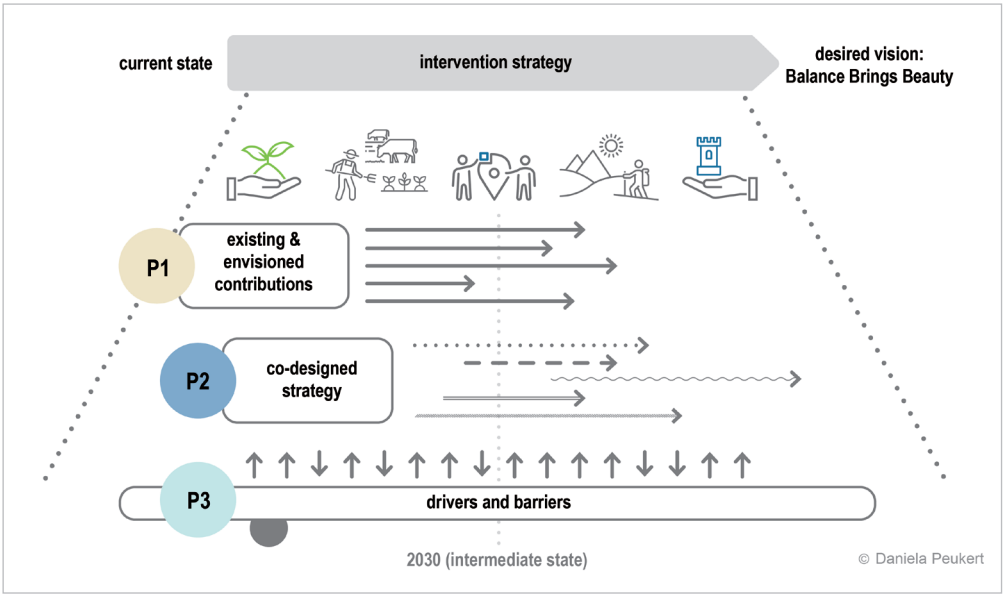

Figure 3.6 Main steps for co-designing intervention strategies to progress from the current situation to a desired future state. Figure by © Daniela Peukert

Collaborative approaches: landscape stewardship

The notion of landscape stewardship is especially relevant for designing rural development policies for multifunctional land-use systems that are shaped by close interactions between local people and local ecosystems. Landscape stewardship inclusive of forest stewardship provides a collaborative approach for the governance of complex landscapes that is complementary to other top-down forms of governance (Bieling and Plieninger 2017). Landscape stewardship relies on forms of human-nature interaction, whereby humans are encouraged to interact with the landscape with care and responsibility while deriving a diverse set of benefits (Cockburn et al. 2020) which are aligned with the circular-bioeconomy paradigm. This co-creational approach takes into account governing landscapes not only for productivity and for tangible ecosystem services, but also for promoting intangible values such as local identities and aesthetics in order to achieve transformative change. It draws on the shared values, knowledge and the agency of local residents, communities, farmers, researchers, government officials and non-governmental organizations; it further points to the importance of a rural policy environment that encourages and enables plurality and the active involvement of civil society in developing a sustainable bioeconomy (such as explained in chapter 2.2 and here). Working together in such a diverse configuration involves experimenting and cultivating new ways of knowing and doing, hence making possible innovative landscape stewardship practices for a sustainable Romanian bioeconomy tailored to its rural particularities. Potential limitations of landscape stewardship revolve around trade-offs between openness to plurality and decreased efficiency, or the difficulty to maintain, for longer periods of time, constant levels of engagement and of responsibility from all landscape stewards. One local example of a Landscape Stewardship Working Group is provided by the Harghita County Council. It assembles university experts from fields of knowledge such as wildlife and forestry, nature conservation, social sciences, agriculture, rural development, economics, and representatives of governmental institutions, non-governmental organizations and local communities. Its mission is to ensure cross-sectoral cooperation between institutions and disciplines in order to preserve and promote the biocultural capital of Harghita County, with a special view on managing human-carnivore coexistence in the county.

Summary

Rural development is a challenging systemic and complex problem; there is no definite formulation of the problem as all those involved perceive it from the perspective of their own relationships with the environment. Rural landscapes are characterized by complex and diverse human-nature relations underpinned by various needs, capabilities and values. Competing land-use interests create trade-offs between production, conservation and the social goals of landscape management. Navigating this challenging diversity, while conserving a natural heritage and responding to global pressures and local aspirations, constitutes a delicate balancing act for sustainable rural development in Romania. This chapter sought to emphasize those elements usually overlooked in policy design, which may contribute to a rural development supportive of a resilient forest bioeconomy in a country like Romania. These key elements are: i) action at deep leverage points such as deeply held values; ii) action inclusive of local sustainability initiatives; iii) action through collaborative approaches and in partnership with local change agents from the public, private and academic sectors.

Take-home messages:

- The latest literature calls for a design of interventional policies that takes a holistic systems view, and targets both the shallow and deep leverage points of a system, be it the energy system, food system, mobility system or social system of a given country, region, or place. Although easier to design, the effectiveness of numerous current policies that focus on shallow leverage points (e.g., taxes, incentives, indicators) is brought into question.
- In this context, focusing on measurable and monetizable parameters needs to be complemented with attention given to less tangible but more transformation-effective deep leverage points such as values, paradigms and intent.
- Rural development that builds on what is already working locally, that capitalizes on existing sustainability initiatives and integrates the efforts to change of local practitioners is more likely to generate change that involves a sustainable future and human wellbeing.
- An active partnership where power and responsibility are shared among practitioners, researchers and authorities is likely to increase the ability to address the problem of landscape management; landscape stewardship is a salient and established approach to such a partnership. In Romania, the Agricultural Payments and Intervention Agency (APIA) has some attributions in this regard, as farmers and potentially landscape stewards who receive agricultural payments need to respect Statutory Management Requirements (SMRs) and Good Agricultural and Environmental Conditions (GAECs). Similarly, the Romanian Ministry of Environment, Waters and Forests has attributions regarding the European Landscape Convention; most environmentalists criticize the lack of an integrated and systematic approach for considering the landscape scale. However, there is no officially designated institution with direct competencies in landscape stewardship.

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3.4 Forest Education in the Era of Bioeconomy

Laura Bouriaud

Why it is important to adapt the forest education system to meet the requirements of the bioeconomy

The European bioeconomy strategy aims "to pave the way to a more innovative, resource-efficient and competitive society that reconciles food security with the sustainable use of biotic renewable resources for industrial purposes while ensuring environmental protection" (European Commission 2012: 2). Innovation is the key to transitioning towards bioeconomy. Irrespective of the model of innovation taken into consideration, research and education organizations are a core element of the innovation system, as multipliers of system change (Peer and Stoeglehner 2013). In addition to knowledge creation, academic education has a transformative mission to convey practical and reflexive knowledge, as well as to empower individuals (Urmetzer et al. 2020). Changing employment and societal needs require modern teaching approaches and methods (Rodríguez-Piñeros et al. 2020). In particular, universities are required to address the increasing demand for interdisciplinary skills (Lewandowski 2018) and to close the gap between employers' needs and students' competencies, particularly in soft skills, knowledge skills, technical skills and work culture (Bernsen 2020). Classical forestry teaching should be complemented with knowledge about industrial bio-based products and bioeconomy-related services with the aim to foster a culture of collaboration amongst value chain actors (Singh et al. 2021) and a culture of innovation (Masiero et al. 2020). Since bioeconomy is a recent concept, building a bioeconomy-based education system in universities is still at an early stage (Masiero et al. 2020).

This chapter addresses the main challenges that the forestry education system faces as it strives to foster a culture of innovation and to achieve bioeconomy-sound practices in the Romanian forest-based sector. We focus mainly on forestry education, i.e., silviculture, forest management, and administration – understood here as the first segment of the forest sector value chain. A focus on this first segment in forestry education is important, as these fundamental forestry activities determine the provisioning of a large set of ecosystem services, important for both domestic industry and local communities.

Background: Romanian forestry education status quo and inherent challenges

The forestry education system in Romania has several components: high forestry schools and forestry vocational schools, forestry university education (a 4-years Bachelor degree to gain a forest engineer qualification, and a 2-year master' program), and forestry doctoral school (a 3-years Ph.D. program to obtain a Doctoral degree).

A few years ago, the first professional forest qualification could be obtained, at lower-level education, in forestry high schools, after a four years taught program. Over time, the number of forestry high schools has grown. Initially, in the early 1990's, there were six forestry

high schools (Câmpulung Moldovenesc, Năsăud, Timişoara, Brăneşti, Braşov and Gurghiu) evenly distributed to cover most historical regions of the country. Since then numerous forestry classes were created in high schools with a technological vocation (Fem4Forests Report 2020). In 2012, private education providers started to deliver diplomas for 'forest guard qualification' after only several months of study. In 2015, a ministerial order downgraded the required qualification as forest guard from level 2 (ISCO 08: 2132 - Farming, forestry, and fisheries advisers) to level 3 (ISCO 08: 3143 - Forestry technicians). This measure came in the context of increasing exigencies placed on the forestry profession challenged, in its own turn, by the increasing complexity of problems that foresters at the forest management unit level were confronted with. Such problems included adopting specific conservation measures in certain habitats, forestry adaptation to climate change, new technologies imposed by the electronic timber tracking system SUMAL, etc. A major challenge is, therefore, posed by the need to reconsider the adequate level of qualification for the technical forestry staff. If the forest profession is to play a more central role in the bioeconomy, the re-professionalization and the re-valorization of the forest guard's role – as manager of the forest ecosystem in rural areas – are compulsory steps that should not be bypassed.

Academic education in forestry currently involves a four-year bachelor's degree which delivers a "forest engineer" diploma, complemented by a Master's program of four semesters. There are two main faculties, in Braşov and Suceava, and four departments of Forestry in agricultural universities in Timişoara, Cluj Napoca, Craiova, and Bucureşti, and one department of Forestry at the Faculty of Environmental Protection in Oradea. In Suceava, the number of forest engineer graduates was on average 40 per year in the last 10 years, with a 21% female representation (Fem4Forest Report 2020). In Brasov, around 180 students enrolled in the forestry programs, and as in the case of the university in Suceava, the drop-out rate is significant. There is, however, ongoing discussion about whether the number of forestry engineers graduating each year from Romanian universities is too high. This is questionable since, according to data from 2017, Romania's population with a university degree counts 26%, ranking the lowest in Europe. Therefore, the more relevant discussion is not about the number of forest engineer graduates, but rather, the recruitment process.

As long as recruitment processes continue to be marred by inefficiency, lack of transparency, or corruption (Bouriaud and Marzano 2015), the forest administration structures will not be able to select the best-skilled forestry students. The lack of transparent and fair competition in the recruitment of forest engineers has negative effects on both employers and education providers, putting at risk organizational performance and demotivating students in their learning efforts. Therefore, a recruitment process should be based on competence and standardized procedures and would need stronger cooperation between the universities and potential employers. For example, a national admission program to forest administration jobs that is jointly led by employers and education providers could set up recruitment procedures based on qualifications and eliminate corrupted or inefficient practices. In addition, internships, mentoring, and agreed technical studies could bring education programs closer to meeting societal and economic needs. Despite existing cooperation agreements between sector stakeholders and education providers, there are in fact few directly transferable student contributions that address forestry or industrial needs. One positive example of student-industry collaboration is that of a group of students from Transilvania University who helped

improve the utilization study done for the National Forest administration[30].

Particularly at the Ph.D. level, more active knowledge transfer between the research output of doctoral students and the needs of the forest industry is needed. Currently, there are two Ph.D. programs in Forestry offered by University Transilvania from Brașov and University Ștefan cel Mare of Suceava, with 60 Ph.D. students currently enrolled (44 in Transilvania, 20 in Suceava). The growth in the number of PhD students is due to universities' improved fundraising capacities, e.g., via participation in international consortiums, over the past 15 years (Fp7, Horizon 2020), resulting in increased research visibility and competitiveness of the Romanian forest education. For example, the University Ștefan cel Mare of Suceava is a member of the research consortium BeonNAT which aims to develop innovative products from underutilized plant biomass as feedstock for the bio-based industry. Despite such positive developments, Romania is far from reaching the number of doctoral research studies needed to identify problems and find the solutions that the future forest-based bioeconomy could bring.

Building bridges between academia and innovation systems

The subject of bioeconomy could be addressed and further developed in both the academic curricula and doctoral research if more public financing would be made available to support this endeavor[31]. If the inherent challenges of the research and educational system are overcome, there will be several fields where progress can be expected: innovation, interdisciplinarity, a culture of cooperation and problem-solving skills.

The presence of doctoral research in this subject reflects both the available public interest in financing research-innovation activities and the university's capability to address urgent societal or technological needs. Due to rapid technological advancement, the product innovation coming from the industry (e.g., biorefineries) tends to be more visible than bioeconomy innovations relying on forest-based services (Weiss 2021). Framing bioeconomy as a technologically-driven endeavor is in fact minimizing the role of process-based innovations. In the context of the Romanian forest-based sector – characterized by a rigid regulatory framework, a lack of infrastructure and investments, and a market-oriented towards low-processed products – process-based innovations are more likely to occur than product innovations. In the current innovation-adverse environment, successful stories of innovative forestry practices and collaborative actions are highly valuable. People's capabilities and their

[30]Study regarding the calculation of the technical specifications following the modernization of the harvesting equipment in RNP Romsilva, project financed by RNP Romsilva to support students' applied research, Available at https://silvic.unitbv.ro/ro/stiri-si-evenimente/593-studiu-privind-stabilirea-consumurilor-de-combustibili-si-a-normelor-de-timp-si-productie-in-activitatea-de-colectare-a-lemnului-ca-urmare-a-modernizarii-parcului-de-utilaje-al-unitatilor-regiei-proiect-finantat-de-rnp-romsilva-care-sustine-cercetarea-aplicata-a-studentilor-facultatii.html

[31]In November 2021, University Stefan cel Mare of Suceava won in the national competition an institutional project for increasing capacities for research, development, and multi-disciplinary innovation in the bioeconomy field (budget of 1,28 million euro), in which the forestry field will benefit from research on technological development on biomass estimation and wood traceability Transilvania University of Brasov has won in January 2021 a research project on Changing paradigm in wood measurement, in the call Fundamental and exploratory research run by Executive Unit for Financing Higher Education, Research, Development and Innovation (UEFISCDI).

soft skills are vital ways in which one can valorize scarce system opportunities. Therefore, substantial support for a bioeconomy-based forest sector could come from universities that can provide society with well-educated and skilled specialists, and also educate young people in the spirit of high deontological standards, reflexive thinking and problem-oriented learning (Masiero et al. 2020; Bernsen 2020).

An interdisciplinary approach is needed to enable students to understand how the forest-based sector can be integrated into the international market and respond to current societal needs. There are good examples of such an inter-disciplinary approach. For example, at the University of Suceava, the curricula have been enriched since the late 2000s, and it includes socio-economic courses which introduce subjects related to Natura 2000 network or complement the classical forestry courses with new concepts related to biodiversity, climate change, or private forestry. Courses on social conflicts over the use of forest resources are also meant to improve the students' communication skills and equip them with the necessary soft skills needed to work and successfully cooperate with forest-dependent rural communities (Bernsen 2020). Currently, introducing new courses in the curricula is restricted by the public regulation in force; there are a limited number of disciplines approved by the Ministry of Education for the forestry university program.

Take-home messages:

- Forestry education needs to be able to equip the next generation of forestry professionals with the right skillset to successfully address rapidly changing societal and technological developments i.e., silvicultural practices adapted to climate change, habitat, and stand-specific silvicultural measures, or the increasing digitalization of forest measurement, inventory, and timber traceability. The duration of the undergraduate forestry courses (of only 6 months at present) should be extended and the courses be re-considered to guarantee a proper qualification of the technical forest staff.
- There are good preconditions for a forestry educational system which integrates economy, society and natural sciences at the level of university and doctoral education. Research and education could mainly support process-based innovation (i.e., improved management, enhanced organizational culture, optimization of information flow, digitalization and real-time data on organization production system, improved wood selling procedures, opening the forestry to the social and market demands) and innovation in forest-based bioeconomy services (i.e., accessing modern markets for forest-related services, eco-labeling, investing in social and tourism-related activities, pricing carbon sequestration service, developing educational and recreational paths, innovation in forest-related cultural services).
- Ensuring bioeconomy-sound practices in the forest sector requires well-skilled and innovation-oriented staff. University education needs to provide graduates with problem-solving skills and collaborative learning capacities. Moreover, an

agreement between the forest administration and education providers is needed to promote competency-based recruitment. Also, a more integrative vision of the forest sector (from forests to bio-based products) must be promoted, which could strengthen the cooperation between the bio-based industries and the forestry universities.

- A debate on the elaboration of a new National Forest Strategy is forthcoming. In this context, a new strategic vision about the role of forestry in Romanian society will create the opportunity for developing bioeconomy-sound approaches and for capitalizing on local knowledge and expertise. The education challenge ahead is to empower individuals with soft skills and interdisciplinary knowledge to foster a culture of bioeconomy-based innovation.

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THE WAY FORWARD

The forest-based bioeconomy is cross-sectoral and inter-disciplinary. This book has addressed this concept from different perspectives including management, innovation and governance, to name a few. On that basis, this section will sketch out a concrete action plan for how a sustainable and socially-inclusive bioeconomy can unfold. Based on the recommendations for action provided by the contributors to this volume, the vision for the "Plan B" proposes an integrative set of measures. These are actionable measures that policymakers and practitioners can implement today in order to move beyond shaping the bioeconomy narrative and towards taking concrete steps to enable a full-fledged forest-bioeconomy transformation. These recommendations are summarized and listed point-by-point for each of the three sections of this book:

I. FOREST MANAGEMENT AND BIODIVERSITY CONSERVATION

- **Continue promoting nature-based active sustainable forest management**. Traditional Romanian management practice favors both large carbon stock in the forest and an active management which can lead to continuous carbon sequestration and reduced forest degradation. Through its **diverse silvicultural methods,** management will produce and maintain the needed **shifting steady-state mosaic** across very **large, well-connected** forest landscapes. Such actively managed mosaic will blend resource use with nature conservation and provide an integrated way of forest management and good grounds for a viable bioeconomy.
- **Value the efforts of forest administrators** for implementing close to nature forest management practices which allow the production of superior assortments of wood with a low environmental impact, and thereby comply with sustainable yield principles.
- **Unlock subsidies and compensations** that enable forest owners to apply best practices for biodiversity conservation and sustainable forest management
- **Design and promote forest management measures applicable to small-scale forestry** and involve forest owners in management decisions.
- **Promote ecosystem services** (such as biodiversity conservation, recreation and cultural values) provided by forests. In other words, include local rural communities, forest owners, and administrators in decision-making to transition to a circular-bioeconomy.
- **Improve forest infrastructure** and invest in modern, more environmentally friendly technologies for timber harvesting and processing.
- **Use (more) forest biomass sustainably and efficiently**. An increase in wood harvests is feasible without hampering the stream of ecosystem services. This may also be conducive to:

    - Developing forest industry-specific supply chains by increasingly adding value to long use wood products;

- Enabling rural access, cultural and local industry infrastructure, with significant positive effects on social inclusion and rural development;
- Creating innovative wood-based products and technologies;
- Unlocking further incentives for different forest-related investments.

II. INNOVATION, TRADE, AND BUSINESS

- **Increase the efficiency of forest administration** to ensure the viability of complex but costly forest management needed for integrating bioeconomy with biodiversity conservation and other ecosystem services.
- **Reduce the bureaucratic burden and the costs for forest administration and market transactions**. This is essential for the Romanian forest-based sector to be competitive on the international markets.
- **Support forest-based bioeconomy entrepreneurship**. Investing in education and training programs. Support programs can enhance the effectiveness of biomass utilization, supply chain, and product portfolio diversification.
- **Build an enabling economic environment for companies in forest-related industries.** Such an enabling environment must not only take the form of subsidies but can be achieved through an unambiguous and easy to enforce regulatory framework.
- **Enable market incentives for vertical integration of value chains through forest consortia** considering: (i) their contribution to climate neutrality by storing carbon in long-lived wood-based products and (ii) the local socio-economic contribution of wood processing activity in relation to the amount of wood consumed.
- **Invest in public-private partnerships at local level**. This could enhance social innovation in bioeconomy activities.
- **Create a cohesion tool**, a "hybrid" organization that tackles divisions across policy sectors and serves as an "innovation broker" for projects and ideas.
- **Establish institutional forms of organization and collaboration** (e.g., cooperatives, associations, NGOs) with relevant stakeholder groups and which include marginalized groups (elderly, physically impaired, women, youth, minorities, the unemployed).
- **Provide and support training schools for developing the necessary skills**, e.g., on management of biological resources, entrepreneurial and communication skills.
- **Simplify and make the monitoring of timber traceability more efficient**, more transparent, and thereby facilitate the implementation of robust due diligence systems for combating illegal logging.
- **Establish the first link of the wood chain of custody** and thereby take a decisive step in optimizing the use of wood in accordance with the cascading principle and sustainable circular bioeconomy.
- **Be proactive in the international timber market**. Being proactive could involve making a prognosis, investing in innovation, or in new products; in this view, Romanian companies can gain a better market position.

- **Use forest certification as a tool to promote sustainable forest management**. The reputation of international standards can improve the image of Romanian forestry and enable access to external markets.
- **Use chain of custody certification as a tool to improve the management of companies**. In this way, the implementation of forest certification can bring value, beyond a simple certificate.
- **Implement effective and transparent monitoring of the implementation of sustainability criteria** for forest biomass. This means **strengthening the collection and analysis of wood biomass production and consumption data.** Updated and consistent data are crucial for monitoring the implementation of sustainability criteria for biomass use.
- **Find ways to improve the energy efficiency of biomass utilization** for heating and cooking in rural areas. This is an important prerequisite for accessing important biomass resources for the forest-based bioeconomy.
- **Make biomass-to-energy plants liable to comply with all applicable legislation and deforestation-free requirements**. Industrial operators should have increased responsibilities when sourcing biomass for energy, in order to prohibit the sourcing of wood originating from identified risk zones.

III. SOCIETY, POLICY, AND GOVERNANCE

- **Implement a coherent forest strategy**, which is transparent and socially inclusive, and which is grounded in scientific assessments using a reliable information-based system;
- **Adopt new governance approaches and diversify policy instruments** in order to efficiently use the entire spectrum of ecosystem services, which provide benefits to landowners, local communities and civil society;
- **Combine the policy instruments and differentiate them by forms of ownership and size of forest estates** by including information, incentives, legal and institutional frameworks. This diversification needs e.g. to counteract the negative societal view on forest administration, to support the responsible management of small-scale forest estates, and to finance the provision of regulatory and cultural ecosystem services, including biodiversity conservation.
- **Design and implement an efficient communication strategy promoting sustainable use of forest-based resources**. This must build on specific indicators that transparently monitor the efficiency of implementing policy instruments covering the multiple ecological, social and economic impacts of the forest-based bioeconomy.
- **Create a forest ownership data platform** to identify the spatial distribution of forest ownership, to improve the statistical information regarding forest owners, and to implement regulatory and financial instruments in an effective way.
- **Grant owners more decision-making freedom in managing private forests**. This approach is needed to support the owners' entrepreneurial and innovative inputs related to efficient forest management, and to reduce the multiple bureaucratic

burdens partially leading to illegalities and corruption.

- **Actively and constantly involve forest owners in stakeholder consultations** to identify appropriate policy instruments and to assess the impact of forest policy decisions on their forest management practices. Forest owners need to be pro-actively and constructively involved in the formulation of national strategies and policies, which requires better organizational capacities from their national umbrella associations.
- **Pursue rural development programs that build on what is already working locally**, that capitalize on existing sustainability initiatives, and integrate the efforts to change of local practitioners; this strategy is more likely to generate change and lead to a sustainable future for human wellbeing.
- **Build active partnerships that involve sharing of power and responsibility among practitioners, researchers and authorities.** This will most likely increase the ability of stakeholders to address the problem of landscape management; landscape stewardship is a salient and established approach to such a partnership.
- **Train well-skilled and innovation-oriented staff**. Teaching methods need to provide graduates with enhanced problem-solving skills and collaborative learning capacities to enable inter-sectoral bioeconomy collaborations.
- **Support cooperation programs between the forest administration, the private sector and education providers** in order to promote competency-based recruitment and deliver transferable services and innovations.

The bioeconomy narrative is still in flux, and national governments differ widely in their approach to implementing bioeconomy strategies. As the Romanian government has yet to produce a comprehensive bioeconomy and forest strategy, the authors of this book have taken it upon themselves to provide key strategic directions for developing the forest-based bioeconomy in Romania. This book has laid out the groundwork on which to formulate a sustainable, and socially-inclusive bioeconomy narrative. This narrative takes stock of the Romanian forest-based sector, its natural diversity and the people whose livelihoods depend on forests.

The bioeconomy remains an infinitely interesting subject that can be tackled from different perspectives, disciplines and schools of thought. This book has been an attempt to bring some of these perspectives together. As mentioned at the beginning of this volume, the bioeconomy is one of many approaches aimed at tackling our urgent sustainability problems. In this vein, the recommendations provided above can also be understood as a buffet of different approaches that can be selected, combined and applied according to different contexts and needs. It is up to decision-makers and stakeholders of the forest sector to create a concrete and feasible forest-based bioeconomy policy beyond the current rhetorical commitments. If there is one important lesson to be learned from this book, it is that there is no one-size-fits-all solution when it comes to designing a coherent and socially-inclusive bioeconomy strategy. Although the European Commission has led the way in reinvigorating and promoting the bioeconomy paradigm, Romania will have to find its own bioeconomy path, building on its natural resources and social capital, while carefully taking into account its cultural heritage, social realities and economic challenges. In this respect, we hope to have provided the reader with a comprehensive, forward-looking, fact-based and hopefully unbiased plan for putting Romania's forests and society on the sustainable, circular-bioeconomy path.

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Besides being an intellectual experiment, this book was also a cooperation experiment. The authors were not only open to discussing ideas, and engaging with this complex interdisciplinary concept, but also actively supported the peer-to-peer reviewing process whilst maintaining an inspiring sense of collegiality and mutual support. For this, we are extremely grateful, since it made our work as editors so much easier. Special thanks goes to Tudor Stăncioiu and Liviu Nichiforel who served as friendly sparring partners offered valuable advice throughout the entire process and put us in contact with the professionals that helped us turn this idea into a reality. We would also like to thank Marian Drăgoi, who readily agreed to serve as an external reviewer back when we were still tying together loose ends. We are deeply grateful for Marian's valuable advice for improvement. Our appreciation also goes to Victor Păcurar for also reviewing this book.

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DISCLAIMER

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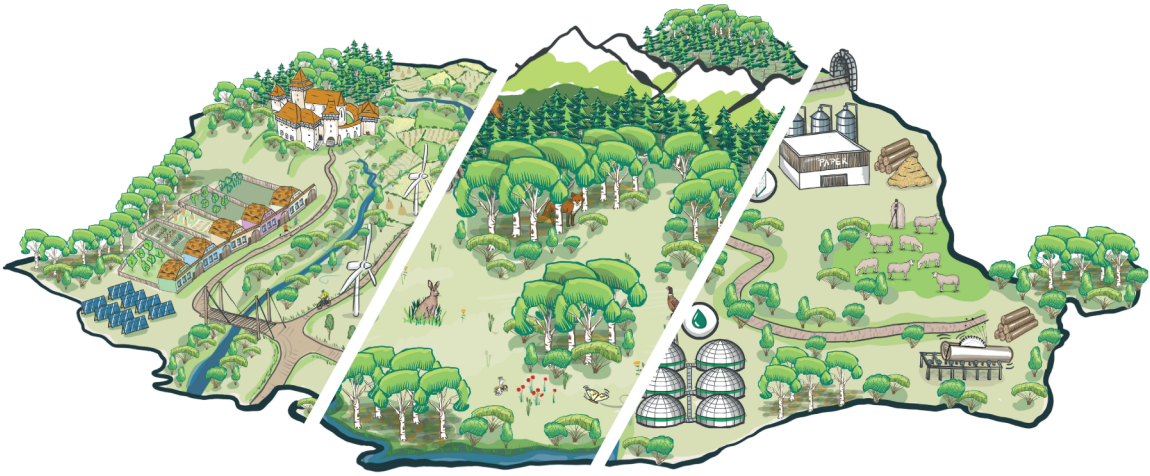
The Plan B for Romania's Forests and Society

What if forests would be at the heart of a revolutionary sustainable transformation of our economy and society?



Circular bioeconomy is the oldest concept on the planet Earth. Nature is a bioeconomy organized in line with the principles of the circularity. Nothing is lost and everything has its purpose. The Dasgupta Review as one of the main reasons for problems we face highlights the failure of contemporary economics to acknowledge that humans are embedded in, and not external to nature, and to act accordingly. The book, using the forests optic, is an important contribution to the sustainability vision of the country, where nature is still intact and rich.

Janez Potočnik, former European Commissioner for the Environment

Plan B must become Plan A. There is no alternative. This emerges clearly from this book that places the forest sector at the center of the transition to a circular and sustainable bioeconomy. Bioeconomy is about local regeneration and new jobs. It's a new paradigm to reconcile economy, society and the environment. The present and the future of Romania, Europe and the whole world is here.

Mario Bonaccorso, founder and Editor-in-Chief II Bioeconomista, The First Bioeconomy Blog