Norwegian University of Life Sciences
Faculty of Landscape and Society
Department of International Environment
and Development Studies

Philosophiae Doctor (PhD)
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Plural values and governance of Norwegian forests for sustainable community development

Mangfald i verdiar og forvalting av norsk skog for berekraftig samfunnsutvikling

Elisabeth Veivåg Helseth

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In memory of Ketil Skogen (1955–2023)

Summary of thesis

Most land-based species of animals, plants, and insects live in forests, and forests contribute multiple benefits and ecosystem services to human well-being, such as raw materials, carbon sequestration, food, and recreation. However, forest ecosystems are degraded worldwide, with subsequent declines in biodiversity and ecosystem services. The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) has stated that the causes of the global nature crisis are linked to the way we value nature, and to the institutions and power dynamics defining which values are prioritized or excluded in political and economic decisions at all levels of society. This points to a need for deeper knowledge of the role of plural values and institutions in promoting sustainability transformations globally and locally.

Drawing on theory from ecological economics and institutional economics, this thesis uses Norwegian forest governance as a case to examine how values and institutions shape the condition and trends of forest ecosystems, which forest benefits are prioritized and to whom. The thesis further examines how different approaches to valuing and governing forest ecosystems can promote transformative changes toward sustainable community development. Specifically, I i) identify and explain trends and drivers of change of Norwegian forest ecosystem services from 1950 to 2020, ii) assess the role of economic instruments in safeguarding or impeding forest ecosystem service diversity, iii) assess how institutions restrain or mobilize different forest values, and iv) map how values associated with competing sustainability pathways are reflected in rural policies and in people's sustainability conceptions.

Through a mixed methods approach that includes policy reviews, in-depth interviews (N = 15), and a survey distributed among inhabitants in twelve rural municipalities in Norway (N = 3591), the thesis reveals major imbalances in the ecosystem services and values promoted by Norwegian forest governances, as well as power asymmetries resulting in unequal distribution of forests benefits. Specifically, I find that i) Norwegian forest governance has largely favored provisioning ecosystem services (such as timber) at the expense of many supporting, cultural, and regulating services, ii) tradeoffs in favor of timber production are sustained by government expenditures combined with a dominance of market-oriented valuation, iii) although citizens express diverse intrinsic and relational values in connection to forests, value-articulating institutions

disproportionally favor instrumental and monetary values, and iv) there are few institutions that empower citizens to participate in deliberation of forest governance or future sustainability pathways.

The thesis shows that while Norwegian citizens are granted the *right to roam* in forests, their *right to govern* forests remains marginal. I also find that both forest governance and rural policies in Norway are dominated by a *green growth* sustainability pathway, promoting utility, efficiency, and instrumental values, whereas alternative sustainability pathways with stronger emphasis on intrinsic and relational values tend to be sidelined. In line with recent trends in the sustainability sciences, the results of this thesis indicate that governing forests for sustainable community development will require a broader *pluralism of values*, including a shift away from competitiveness and utility, toward considerations of care, reciprocity, and justice. In this regard, the thesis makes a case for moving beyond the dominating *green growth* pathway, to allow for deliberation of alternative sustainability pathways such as *degrowth*, *earth stewardship*, and *nature protection.* I argue that broad deliberation of sustainability pathways and associated values is a key component of sustainability transformations and sustainable forest governance.

In summary, the thesis contributes a broad and interdisciplinary analysis, integrating knowledge from economics, social sciences, and ecology, to examine the role of forest values and institutions for sustainable community development.

Samandrag av avhandlinga

Dei fleste landbaserte artar av dyr, planter og insekt bur i skog, og skogar bidreg med mange viktige økosystemtenester til samfunna våre, som mellom anna råvarer, karbonbinding, mat, og rekreasjon. Likevel vert skogøkosystem over heile verda forringa, med påfølgjande tap av biologisk mangfald og økosystemtenester. Det internasjonale naturpanelet (IPBES) hevdar at den globale naturkrisa heng tett saman med måten vi verdset naturen på, og med institusjonar og maktdynamikkar som definerer kva verdiar som vinn fram i politiske og økonomiske avgjerder, på alle nivå i samfunnet. Dette peiker mot eit behov for djupare forståing av kva rolle ulike verdiar og samfunnsmessige institusjonar spelar for berekraftsendringar globalt og lokalt.

Basert på teori frå økologisk økonomi og institusjonell økonomi gjennomfører eg ein eksempelstudie av norsk skogforvalting. Eg undersøkjer korleis verdiar og institusjonar formar tilstand og trendar for skogøkosystem, kva skogverdiar som vert prioritert, og for kven. Avhandlinga undersøkjer også korleis ulike tilnærmingar til å verdsette og forvalte skogøkosystem kan fremja gjennomgripande endringar i retning berekraftig samfunnsutvikling. Prosjektet i) identifiserer og forklarar trendar og endringsdrivarar i norske skogøkosystemtenester frå 1950 til 2020, ii) vurderer kva rolle økonomiske verkemiddel har med tanke på å ivareta eller hindre mangfald av skogøkosystemtenester, iii) vurderer korleis institusjonar hindrar eller mobiliserer ulike verdiar knytt til skog, og iv) kartlegg korleis verdiar assosiert med ulike *berekraftsbanar* vert reflektert i distriktspolitikk og i folk sine oppfatningar av berekraft.

Eg nyttar metodetriangulering som inkluderer dokumentgjennomgang, djupneintervju (N = 15) og ei spørjeundersøking blant innbyggjarar i tolv distriktskommunar i Noreg (N = 3591). Resultata viser omfattande ubalanse i kva type økosystemtenester og verdiar som vert fremma i norsk skogforvalting, samt maktskeivhetar som resulterer i ulik fordeling av godar frå skog. Konkret finn eg at i) norsk skogforvaltning i stor grad har favorisert forsynande økosystemtenester (som tømmer) framfor mange støttande, kulturelle, og regulerande tenester, ii) avvegingar til fordel for tømmerproduksjon blir støtta opp gjennom offentlege utgifter, kombinert med dominans av marknadsbasert verdsetting, iii) sjølv om innbyggjarar gir uttrykk for eit mangfald av ibuande og relasjonelle verdiar knytt til skog, bidreg verdiartikulerande institusjonar til ei uforholdsmessig favorisering av instrumentelle og pengemessige verdiar, og iv) det er få

institusjonar som myndiggjer innbyggjarane med tanke på medverknad i skogforvaltninga, eller i å definere framtidige berekraftsbanar for samfunnsutviklinga.

Resultata viser at mens «allemannsretten» sikrar norske innbyggjarar ein rett til å ferdast fritt i skog, er deira rett til å forvalte skogen marginal. Eg finn også at norsk skogforvalting og distriktspolitikk fremjar *grøn vekst* som ein dominerande berekraftsbane, med vekt på nytte, effektivitet, og instrumentelle verdiar. Alternative berekraftsbanar, med sterkare vekt på ibuande og relasjonelle verdiar, vert derimot satt på sidelinja. I tråd med kunnskapsutviklinga innan berekraftsvitskap, indikerer resultata at forvalting av skogøkosystem for berekraftig samfunnsutvikling vil krevja eit *breiare mangfald av verdiar*, inkludert eit skifte vekk frå konkurranseevne og nytte, i retning av omsorg, gjensidigheit, og rettferd. Her peiker eg på eit behov for at både skogforvalting og distriktspolitikk bevegar seg bortanfor den dominerande tankegongen om *grøn vekst*, og at det vert lagt til rette for medverknad knytt til alternative berekraftsbanar slik som *vekstfri utvikling*, *tradisjonsbasert forvaltarskap*, og *naturvern*. Eg argumenterer for at brei medverknad knytt til drøfting av slike berekraftsbanar og tilhøyrande grunnleggande verdiar, er ein nøkkelfaktor for berekraftsendringar og berekraftig skogforvalting.

Oppsummert bidreg avhandlinga med ein brei og tverrfagleg analyse, som integrerer kunnskap frå økonomi, samfunnsvitskap, og økologi, for å undersøkje korleis mangfald i skogverdiar og institusjonar kan fremma berekraftig samfunnsutvikling.

Acknowledgments

I had been warned that a PhD project is a lonely process. I guess some parts were inevitably lonely, but I have boundless gratitude to all those who have made my PhD journey one of friendships and academic belonging. Your support was particularly important for me to stay (somewhat) on track during the Covid lockdowns. In addition to all the interview informants and survey respondents who contributed to this research, there are many I want to thank.

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least Erik Framstad – whose comprehensive knowledge on Norwegian forests was of key importance for the work on the first article. At NINA, I also want to send my gratitude to Kristin Evensen Mathiesen, for your patience, encouragement, and positive energy during the last months of the PhD work, and to Vegard Gundersen, for your support and feedback on the thesis.

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Main abbreviations and acronyms

ECOREAL	Real-world ecosystem management: Identifying knowledge gaps and overcoming societal barriers (Norwegian research project)
Km^2	Square kilometer
m^3	Cubic meter
MAF	The Norwegian Ministry of Agriculture and Food
MCE	The Norwegian Ministry of Climate and Environment
MEA	Millennium Ecosystem Assessment
NAA	Norwegian Agriculture Agency
NEA	Norwegian Environment Agency
IPBES	Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services
IPCC	International Panel on Climate Change
NCCRD	Norwegian Centre for Competence on Rural Development
NCP	Nature's contributions to people
SDGs	The United Nation Sustainable Development Goals
TEEB	The Economics of Ecosystems and Biodiversity
UN	The United Nations
UN-SEEA	United Nations System of Environmental-Economic Accounting
VAI	Value-articulating institution

If you are going to produce something efficiently, you have to centralize. You have to get rid of the diversity in a way. A large diversity is not particularly effective. If you are going to produce something, you have to take away part of the diversity, in order for this to be economically profitable. So, in a competitive situation, you will constantly be under pressure to simplify. Take away diversity and simplify, to become better and better at producing. As long as you do not have an economic value on nature, nature will always be the loser. Or diversity, then. (Norwegian forest expert, in-depth interview 2021, my translation).

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Part 1: Introductory Essay

> Transformation to sustainability is found to require a) a rebalancing of human-human values, away from the dominance of individualism and economic profit towards sustainability-aligned values of collectivism, care and justice; and b) a rebalancing of human-nature values, away from the dominance of instrumental values, towards inclusion of values based on care and respect for other-than-human nature (IPBES, 2022a:354).

1. Introduction

The majority of all terrestrial species of animals, plants and insects live in forests (FAO, 2020b) and forests provide multiple ecosystem services to people and communities, such as raw materials, carbon sequestration, food, and recreation (Brockerhoff et al., 2017; Jenkins & Schaap, 2018). Global ecosystem assessments (IPBES, 2019; MEA, 2005; TEEB, 2010) find that forest ecosystem services are in decline worldwide due to deforestation and forest degradation. Although some regions, such as Europe, have net growth in forest biomass, this growth coincides with fragmentation and changes in forest functions following accumulative anthropogenic pressure (Díaz et al., 2019; FAO, 2020a).

Despite rapid advancements in methods to integrate the multiple values and contributions of forests in decision-making (see e.g., Arias-Arévalo et al., 2018; Chan et al., 2012a; De Groot et al., 2002; Gómez-Baggethun et al., 2010; Gómez-Baggethun et al., 2014; IPBES, 2022a) ecological and cultural values of forests are relegated to marked-based instrumental values worldwide (IPBES, 2022a). While different policy initiatives, such as the global Aichi Biodiversity targets (2010; 2022) and the EU Taxonomy Compass (2022), call for reforms in economic incentives to promote conservation and sustainable use of forests, forest ecosystems are under growing pressure from economic incentives that "hide environmental and social costs" (IPBES, 2019:30).

The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) states that the causes of the global nature crisis are linked to the way we value nature as well as to the institutions and power dynamics defining which values are prioritized or excluded in political and economic decisions at all levels of society (IPBES, 2022a). Furthermore, alerting that gradual change approaches are not sufficient to

achieve global sustainability targets, IPBES and the International Panel on Climate Change [IPCC] (2019; 2022) make a case for *transformative change,* described as "fundamental, system-wide reorganisation across technological, economic and social factors, including paradigms, goals and values" (IPBES, 2022a:544). Such changes go deep, for example through emphasizing "changes to underlying drivers, including consumption preferences, beliefs, ideologies and social inequalities" (IPBES, 2022a:544).

The call for transformative change reinforces attention to the role of institutions (conventions, norms, and legal rules) in defining societal goals, and which (and whose) values are favored in decision-making (IPBES, 2022a; Vatn, 2015). Furthermore, IPBES relates strategies for transformative change to the concept of *sustainability pathways*, defined (2022) as "strateg[ies] for getting to a desired future based on a recognizable body of sustainability thinking and practice, driven by an identifiable coalition of researchers, practitioners, and advocates" (Martin et al., 2022:356). Acknowledging that there exist competing views on what sustainability means, IPBES identify four such *transformative pathways* toward just and sustainable futures (*green economy/green growth*, *degrowth*, *earth stewardship*, and *nature protection*) which are all seen to promote different values and polices (Martin et al., 2022).

These international knowledge developments regarding the values of nature are important to forest governance at national and local levels, such as in Norway. More than one third of the Norwegian land area is covered by forest, and forests have been of great importance to Norwegian communities throughout history (Bækkelund, 2020; Hoen et al., 2019; Kaldal, 2022; Müller, 2018; NIBIO, 2018). Although state-led schemes of reforestation and afforestation have successfully contributed to tripling the forest biomass over the last century (NIBIO, 2019), the ecological condition of forests is considered to be relatively poor[1] (Certain et al., 2011; Framstad et al., 2022), mainly due to industrial forestry (even-aged forestry with clear-felling), and infrastructure developments in forest areas (such as building of roads and recreational homes).

Faced with a shift toward tertiary sector, mechanization, and rural exodus (SSB, 2007; SSB, 2015a; SSB, 2021) forestry related livelihoods are in decline (Kaldal, 2022; SSB,

[1] With a current value of 0.42, against a reference value of 0.6, and an optimal score of 1 (Framstad et al., 2021).

2015b), with corresponding shifts in cultural aspects of human–forest relationships (Kaldal, 2022; Lindhjem & Magnussen, 2012; Nesbakken, 2022).

Over the past decade, multiple assessments have called for redesign of Norwegian forest policies to promote a broader array of forest ecosystems services and values (Kvakkestad et al., 2012; Magnussen et al., 2020; NOU 2013:10, 2013; OECD, 2022). However, few such measures have materialized in concrete forest policies. Furthermore, issues of terrestrial biodiversity are poorly reflected in municipal sustainability planning (Lundberg et al., 2020), and disputes between actors promoting either economic and instrumental values of forests, or ecological and intrinsic forest values, have lately been intensifying (see e.g., Andersen, 2021; Aspøy & Stokland, 2022; Bull-Hansen, 2013; Bølstad, 2019; Müller, 2018). Overall, there is a need for improved knowledge on the institutions and power dynamics of Norwegian forest governance, and their role in promoting or restraining different values of forests for sustainable community development.

1.1. Problem statement and research questions

In the context of biodiversity loss, rural exodus, and calls for sustainability transformations, there is a need to better understand the relationships between forest governance and sustainable community development. The changing trends of Norwegian forests, combined with disputes over forest values and future forest governance, makes it interesting to examine how values and institutions shape the condition and trends of forest ecosystems, which forest benefits are prioritized and to whom. With Norway as a case, this PhD project uses analytical frameworks from ecological and institutional economics to examine *how different approaches to valuing and governing forest ecosystems can promote transformative changes toward sustainable community development.*

The specific research questions guiding the PhD project are:

1. What are the trends, condition, and drivers of change of forest ecosystem services in Norway from 1950 to 2020?
2. In which ways do economic instruments in Norwegian forest governance promote or constrain forests capacity to provide different ecosystem services?
3. What is the role of social preferences, institutional arrangements, and power dynamics in mobilizing or restraining ecosystem services and values in Norwegian forest governance?
4. How are values associated with competing sustainability pathways reflected in rural policies and in people's sustainability conceptions?

1.2. Overview of articles

Article 1: Helseth, E. V., Vedeld, P., Framstad, E., & Gómez-Baggethun, E. (2022). *Forest ecosystem services in Norway: Trends, condition, and drivers of change* (1950–2020). Ecosystem Services, 58, 101491. Ecosystem Services, doi: https://doi.org/10.1016/j.ecoser.2022.101491

Article 2: Helseth, E. V., Vedeld, P., & Gómez-Baggethun, E. (2023). *Unveiling imbalanced investments in forest ecosystem services*. Manuscript.

Article 3: Helseth, E. V., Vedeld, P., Vatn, A., & Gómez-Baggethun, E. (2023). *Value asymmetries in Norwegian forest governance: The role of institutions and power dynamics.* Submitted to Ecological Economics on 3 March 2023. Revised version resubmitted on 14 June 2023.

Article 4: Helseth, E. V., Nordtug, H., Skavhaug, IM., & Gómez-Baggethun, E. (2023). *Beyond green growth: Mapping sustainability pathways for rural transformations in Norway.* Submitted to journal 24 May 2023.

1.3. Outline of the thesis

In Chapter 2, I give and overview of the state-of-the-art knowledge regarding key concept used in the PhD project, such as ecosystem services and human well-being, value pluralism, institutions, and sustainability transformations. Lastly, I focus on the specific case of Norwegian forest governance for sustainable community development. Chapter 3 provides a detailed account of the analytical frameworks and methods used in the project, while Chapter 4 sums up results from the four articles (each answering one of the four research questions). In Chapter 5, I integrate and discuss results from each article to answer the overall problem statement of the PhD project. Lastly, Chapter 6 is a brief conclusion, including an account for theoretical and methodological contributions of the thesis, relevant policy recommendations arising from the results, and reflections on venues for future research.

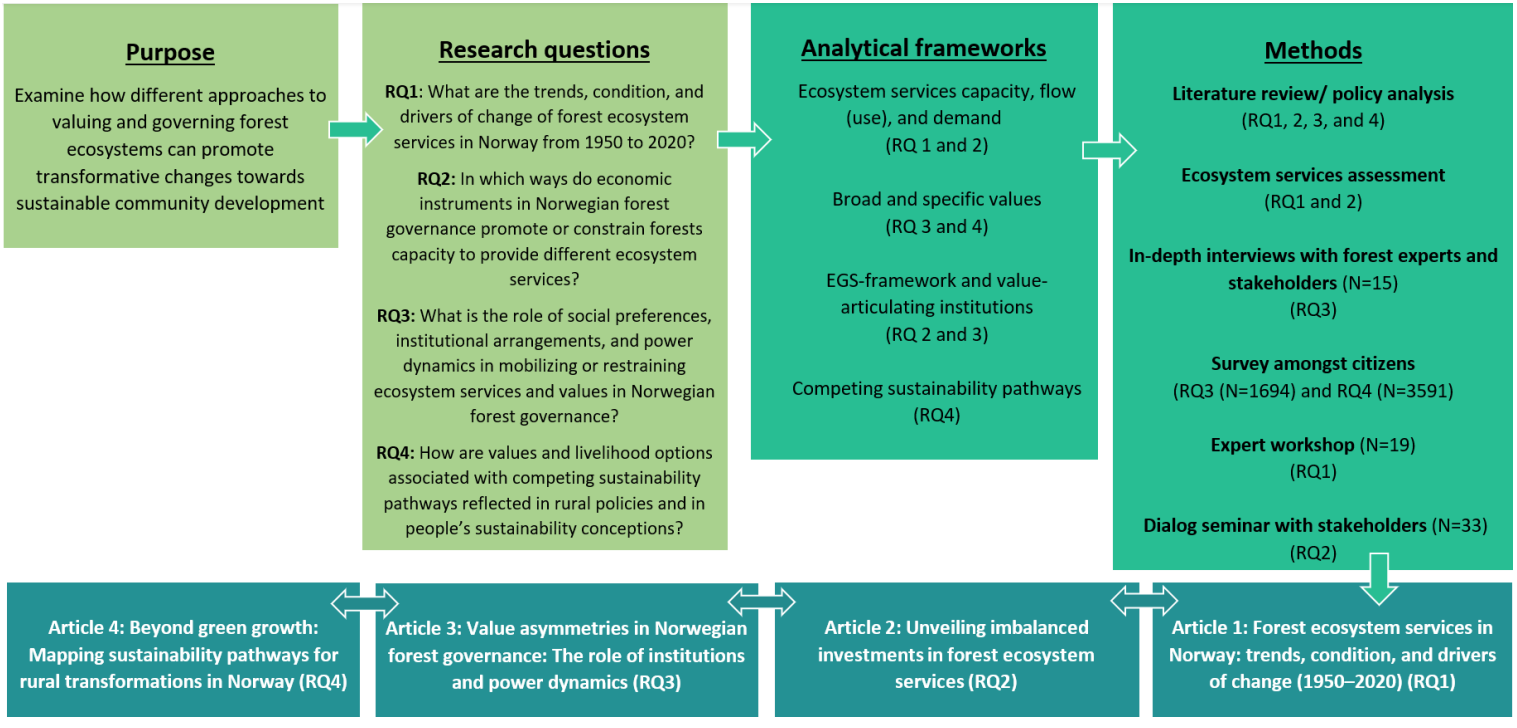

Figure 1: *Overview of purpose, research question, analytical framework, methods (with number of informants/respondents), and articles of the thesis*

2. Background

In this chapter, I first give an account of key concept used in the PhD project, such as ecosystem services and human well-being, value pluralism, institutions, and sustainability transformations, before focusing on Norwegian forest governance and issues of sustainable community development in rural areas of Norway.

2.1. Ecosystem services and human well-being

Environmental economics and ecological economics have contributed significantly to the growing body of research on *ecosystem services*, which emerged from the 1970s onwards. Ecosystem services, defined here as "the direct and indirect contributions of ecosystems to human well-being" (Braat & De Groot, 2012:5; TEEB, 2010), provide an analytical tool to assess the importance of nature for human well-being (ibid.). The initial rationale of the ecosystem service concept was to strengthen awareness regarding the societal dependence on functions and benefits provided by nature (Gómez-Baggethun et al., 2010). The importance of biophysical processes and functions as the foundation for all ecosystem services, and also for human well-being, is illustrated in the cascade model in Figure 2 (Haines-Young & Potschin, 2010:25).

Ecosystem services are often classified into four main categories of provisioning, cultural, regulating, and supporting services (MEA, 2005; TEEB, 2010). A key concern of the ecosystem service concept is to demonstrate the importance of *supporting* service (such as habitat provision) and *regulating* services (such as carbon sequestration) for sustaining *provisioning* services such as timber and food and more intangible *cultural* services such as recreation and spirituality (Chan et al., 2012a; Chan et al., 2012b; Church et al., 2014; MEA, 2020; MEA, 2005; TEEB, 2010). A key argument is that a poor ecological condition and biodiversity loss will undermine the long-term capacity to provide all ecosystem services and associated values and benefits (MEA, 2005; TEEB, 2010).

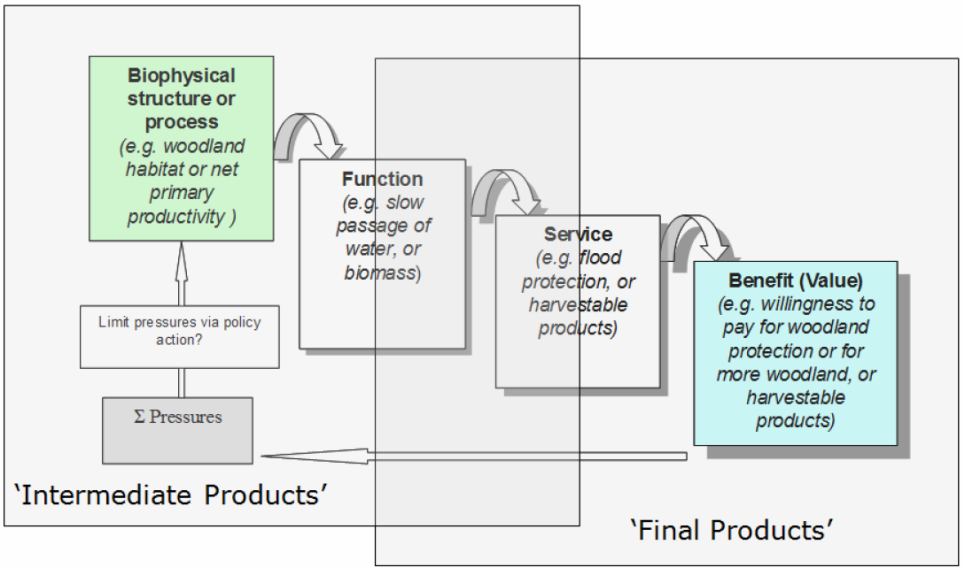

***Figure 2**: The relationship between biodiversity, ecosystem function and human well-being. Source (Haines-Young & Potschin, 2010:25)*

However, despite their fundamental importance for sustaining human well-being, supporting and regulating services are largely relegated to provisioning services with established markets (IPBES, 2022a; MEA, 2005; TEEB, 2010). Turkelboom et al. (2018) define ecosystem service tradeoffs as "land-use or management choices that increase the delivery of one (or more) ecosystem service(s) at the expense of the delivery of other ecosystem services". One main conundrum in *environmental governance* – defined here as "the use, management and protection of environmental resources and processes" (Vatn, 2015:134) – has long been how nature's fundamental contributions to human well-being should be valued, in order to protect biophysical processes and functions from being degraded due to tradeoffs in favor of provisioning services such as raw materials, food, and amenities.

2.2. The role of plural values and institutions in sustainability transformations

There are several approaches to valuation of nature. A monetary valuation approach focuses on how the costs that are not reflected in the market price of a commodified service (so called *externalities*) may be internalized in the economy by "getting the price right" (Dasgupta, 2021; World Bank Group, 2021:8). As an example, the market price of timber does not reflect the costs of habitats that are degraded through timber harvest. For this reason, schemes of timber certification can be implemented to provide a higher price for more sustainably produced timber (following a "provider gets" principle) and/or to sanction those who violate the certification guidelines ("polluter pays" principle) (Gómez-Baggethun & Ruiz-Pérez, 2011; Vatn, 2015). Monetary valuation approaches have developed from early calculations of natural capital (Balmford et al., 2002; Costanza et al., 1997) into global schemes for nature accounting that are now being implemented worldwide (Dasgupta, 2021; SEEA-EA, 2021; UN SEEA, 2023).

Critiques argue that monetary valuation is unsuited to providing needed institutional shifts for sustainability transformations, and that this approach to valuation rather serves as a tool for continued expansion of neoliberal capitalism (Dempsey, 2016). Furthermore, scholars within environmental justice argue that economic development carries unaccounted socio-economic costs that are shifted to third parties (such as nature or future generations) through conscious economic practices, as opposed to accidental market-failures (framed as above-mentioned *externalities*) (Kapp, 1977; Martinez-Alier, 2003). Attention to cost-shifting arising from economic development unites research on values and valuation, with research on *social metabolism* (Daly & Farley, 2011; Georgescu-Roegen, 2011; Kapp, 1977; Martinez-Alier, 2002), here defined as "the physical throughput of the economic system, in terms of the energy and materials associated with economic activities, either as direct or indirect inputs or wastes" (Muradian et al., 2012:560).

While some ecological economists favor monetary valuation of nature (to varying degrees) as a pragmatic approach to biodiversity protection (Balmford et al., 2002; Costanza et al., 1997), others strongly emphasize the *incommensurability* of values (Gómez-Baggethun et al., 2014; Martinez-Alier et al., 1998; Martinez-Alier & Muradian,

2015; O'Neill & Spash, 2000; O'Neill, 2017; Spash, 2008). *Value pluralism*, often defined as "the idea that there are multiple values which in principle may be equally correct and fundamental, and yet conflict with each other" (Gómez-Baggethun et al., 2016:100; see also IPBES, 2022a:546), means that some values might be irreplaceable or incommensurable, and that all values cannot be calculated into the same "currency" (Arias-Arévalo et al., 2018; Gómez-Baggethun et al., 2014; IPBES, 2016). In the tradition of value pluralism, valuation is broadly understood as assigning *importance* and *meaning* (Dendoncker et al., 2013; Gómez-Baggethun et al., 2014; Jacobs et al., 2016).

Over the past decade, IPBES has adopted value pluralism as a favored valuation approach (IPBES, 2016; IPBES, 2022a; Pascual et al., 2017), also emphasizing that the diverging worldviews of different stakeholders must be acknowledged in any valuation process (Pascual et al., 2017). Moreover, arguing that the ecosystem services concept is underpinned by an anthropocentric, Western worldview, IPBES has launched an alternative concept of "nature's contributions to people" (NCP) (Díaz et al., 2018). The term "contributions" is intended to be more relationship-oriented, and NCP is presented as more inclusive of local ecological knowledge and traditional ecological knowledge. However, critiques argue that NCP originates from the same utilitarian framing as ecosystem services, and that sustainability transformations entail a deeper shift in the institutions and *core values* that underpin current human–nature relationships (Kenter & O'Connor, 2022; Muradian & Gómez-Baggethun, 2021). Furthermore, despite advancements in methods and frameworks associated with both ecosystem services and NCP, only 5% of valuation studies globally are reported to have specific policy impact (IPBES, 2022a).

Advancing these valuation debates, the IPBES Values Assessment makes an distinction between *broad* and *specific* values (2022b). Broad values are defined as the "life goals, general guiding principles and orientations towards the world that are informed by people's beliefs and worldviews (Dietz et al., 2005)" (IPBES, 2022a:545). Broad values include both moral principles (such as justice), and life goals (such as prosperity), and are also seen to underpin the ways in which people attribute *specific* instrumental, relational, or intrinsic values to nature. Such specific values are defined as "opinions or judgments regarding the importance of nature in a particular situation or context" (IPBES, 2022a:545).

It is argued that sustainability transformations depend on a shift away from broad values such as materialism, utility, and efficiency, toward values such as care and reciprocity. Mobilizing sustainability-aligned values and shifting social norms and goals are found to work as deeper leverage points for sustainability transformations, compared to undertaking valuation, or embedding plural values in decision-making (Figure 3).

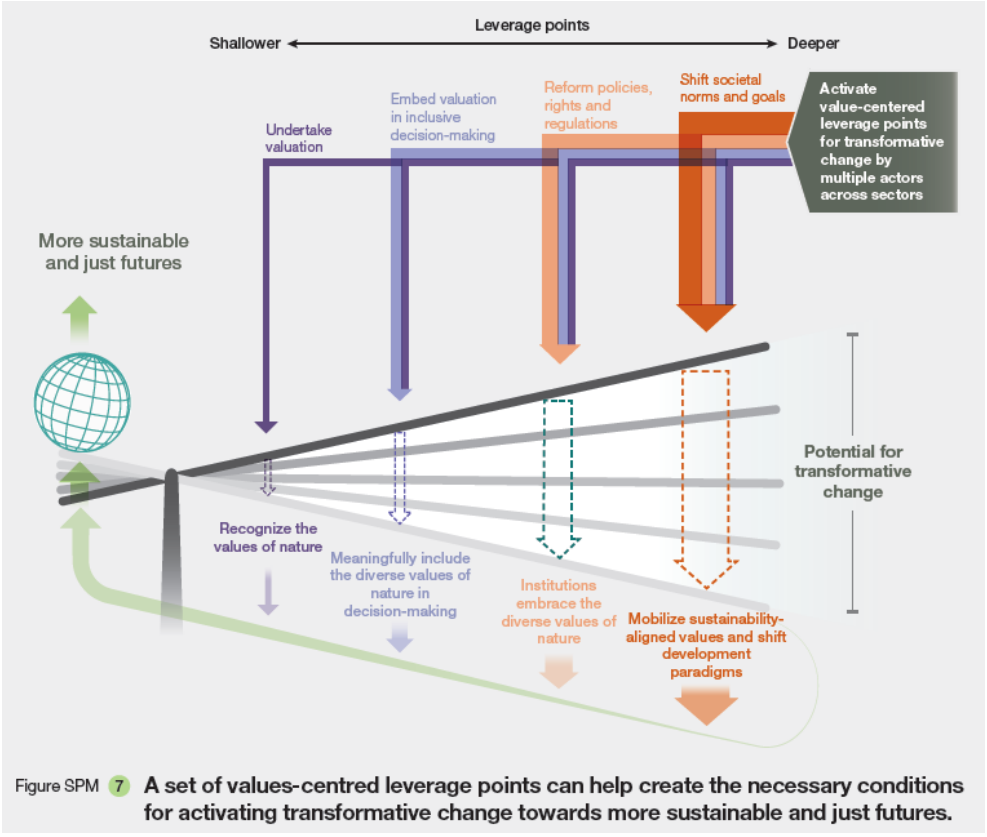

Figure 3: *Values-centered leverage points for transformative change. Source (IPBES, 2022b:37)*

In regard of shifting societal norms and goals, particular attention is given to the role of *institutions*, defined here as "the conventions, norms and formally sanctioned rules of a society" (Vatn, 2015:78), in promoting or inhibiting sustainability-aligned values. Institutional economists have long emphasized that institutions contribute to shaping human motivation and actions (Vatn, 2015), and that "a core goal of public policy should be to facilitate the development of institutions that bring out the best in humans" (Ostrom, 2009a:435-436).

However, the *"understandings of sustainability are diverse and deeply rooted in different cultural contexts"* (IPBES, 2022a:544) and the concept of "sustainability-aligned values" consequently carries layers of normative assumptions. Acknowledging that sustainability conceptions differ, IPBES presents a typology of four diverging sustainability pathways: i) green economy (green growth), ii) degrowth, iii) earth stewardship, and iv) nature protection, which all reflect different values and polices toward sustainable futures.

As an example, the conception of sustainability differs along a *green growth* pathway and a *degrowth* pathway. The global sustainability consensus, deriving from the report "Our Common Future" (WCSD, 1987), promote economic growth as a core element of sustainability (Gómez-Baggethun & Naredo, 2015; United Nations, 2022). This consensus differs from calls for "limits to growth" (Meadows et al., 1972) and urges for the global economy to respect the laws of thermodynamic (Boulding, 1966; Daly & Farley, 2011; Georgescu-Roegen, 1971).

Debates regarding values along diverging sustainability pathways are highly relevant to forest governance. A growing body of research find that continued economic growth comes in conflict with sustainability goals such as halting biodiversity loss (Fanning et al., 2021; Hickel & Kallis, 2020; Jackson & Victor, 2019; O'Neill et al., 2018; Otero et al., 2020; Parrique et al., 2019). However, while European forest governance discourses have followed global meta-discourses on sustainability, there were never a "limits to growth" discourse regarding forests (Edwards et al., 2022). Furthermore, recent research shows that several European countries, including Sweden, have a green growth "more-of-everything" forest policy (Lindahl et al., 2017a; Lindahl et al., 2017b). An entropic view of forest governance, however, such as within Georgescu-Roegen's concept of "bioeconomics" (1971; 2011), emphasizes how the extraction of raw materials and energy inevitably carries costs and consequences, despite being deemed "renewable".

2.3. Case study: Norwegian forest governance

Forests and forest ecosystems have been of great importance to Norwegian communities throughout history, and forests have been used for firewood, housing, food harvesting, hunting and recreation (Hoen et al., 2019). Today, forests cover 37% (121 000 km^2) of the Norwegian land area (323 808 km^2) with a mix of Norway spruce (27.3%), Scots pine (29.6%), birches and other boreal deciduous trees (40%) (NIBIO, 2020b). Around 70% (86 000 km^2) of the forest areas are deemed "productive," defined as forest with a production of at least 1 m^3 timber per hectare per year (SSB, 2023a). The majority of the productive forest areas are concentrated in the southeastern part of the country.

The National Forest Inventory shows that the total biomass in Norwegian forests (measured in cubic meters of timber) has tripled since 1919 (NIBIO, 2019). This increase in biomass is mainly a result of state driven policies, with measures of reforestation and afforestation and even-aged forest management[2] (NIBIO, 2019; Tomter & Dalen, 2018).

In parallel with biomass growth, Norwegian forests has also had fragmentation and deforestation close to settlements (Breidenbach et al., 2017), and a steep decline in "wilderness-like-areas" (NEA, 2018). Around 50% of endangered species in Norway reside in forests, and many of these species depend on old-growth forests as their habitat (Artsdatabanken, 2021; Henriksen & Hilmo, 2015). However, only 4.1% of Norwegian forests are older than 160 years (Tomter & Dalen, 2018), while the share of productive forests that has not been subject to clear-felling is 30% (Storaunet & Rolstad, 2020).

The Norwegian Nature Index indicates that the biodiversity condition of Norwegian forest ecosystems is relatively poor[3] (Storaunet & Framstad, 2020), while a recent assessment of the ecological condition of Norwegian forests established a score of 0.42 against a good condition of 0.6 and an optimal condition[4] of 1 (Certain et al., 2011; Framstad et al., 2022). Main threats to forests ecological condition are considered to be intensive forestry

[2] In 1938, the Norwegian government adopted a forestry plan of reforestation, designed around even-aged forestry (Bækkelund, 2020).
[3] The Norwegian Nature Index is based on a large number of indicators representing different aspects of biodiversity
[4] An optimal condition is seen as a forest ecosystem with minimal human intervention. However, the assessment assumes that it is desirable for society to have some form of active forestry, which should be achievable within the reference level for a 'good condition' (0.6).

practices (even-aged management with clear-felling) and infrastructure developments such as the building of recreational homes and road construction (Framstad et al., 2021).

The dominance of private ownership of forest in Norway is unique in a European context. Private landowners own 77% of the productive forest area of Norway. This high share of privately owned forests is a result of processes of privatization and enclosures that dates back to the 1600s (Gangdal, 2011), and that accelerated during the 1800s (Skogen, 2018). Most of the forest properties are small, with 60% being smaller than 25 ha., and 90% being smaller than 100 ha. The privately owned forest properties amount to a total of 124 551 different properties above 2.5 ha. each (SSB, 2023a). Corporations and co-ownerships own 7.5% of the forest areas, while the state owns approximately 6%. The remaining area of productive forest is owned by municipalities and "village commons" (Statskog, 2015).

Although the forest owners hold most rights to extracting raw material and food from their forests (such as timber and hunting), an important feature of Norwegian forest policy is "the right to roam" (Outdoor Recreation Act, 1957, §2). This right safeguards common access rights to all uncultivated land, including forest areas, for activities such as recreation and harvesting of berries, mushrooms, and wild plants (Reusch, 2021). Forest owners hold the rights to extract timber for forestry, and for hunting and fishing (ibid.).

In the period from 1950 to 2018, employment rates in forestry dropped from 28 500 to 6600 mainly due to mechanization and a shift from primary and secondary sectors to the tertiary sector (SSB, 2015b; Tomter & Dalen, 2018). Although forestry's contribution to the Norwegian GDP declined from 2.5% in 1950 to 0.2% (SSB, 2021), forestry is still important to livelihoods in some areas of Norway (Tomter & Dalen, 2018), and raw materials from forests are framed as essential for a "green shift" toward a "bioeconomy" (Burton et al., 2020; Krøgli et al., 2020; The Norwegian Government, 2016).

Shifts in policies and legislation over the past decades have increasingly emphasized common goods from forest ecosystems, such as carbon sequestration and biodiversity. Currently, 5.5% of Norwegian forests are protected (NEA, 2022), and the Norwegian government has adapted a goal of conserving 10% of the total forest area[5]. Since around 2000, the Payment for Ecosystem Services (PES) scheme of "voluntary forest

[5] The government has not set a specific deadline by when this aim of 10% forest conservation should be achieved.

conservation" have become the favored approach to forest conservation. For this voluntary conservation, the private landowners receive a one-time-payment from the state to conserve some of their forest areas[6] (Frivillig Vern, 2022). The recent Kunming-Monteral nature agreement (MCE, 2022), that calls for 30% of nature to be conserved by 2030, and the implementation of the UN SEEA system for ecosystem accounting UN (SSB, 2021; NINA, 2023; UN SEEA, 2023) add to debates about the best approaches to value and govern Norwegian forests.

The relationships between Norwegian forests and rural communities have changed rapidly over the past decades (SSB, 2015; Kaldal, 2022), with corresponding shifts in human–forests relationship (see e.g., Berglihn & Gómez-Baggethun, 2021; Lindhjem & Magnussen, 2012; Nesbakken, 2022). As rural areas of Norway face the challenges of depopulation and changing demographics (MLGM, 2018), local governments are urged to utilize natural resources, such as forests, to develop attractive communities. If Norwegian forest governance is to align with global calls for sustainability transformations (IPBES, 2022a; IPCC, 2022), as well as national commitments to sustainable development goals (United Nations, 2022) and biodiversity protection (CBD, 2010; MCE, 2022), there is a need for improved knowledge on how different approaches to valuing and governing forest ecosystems can promote transformative changes toward sustainable community development. This includes knowledge about the role of institutions and power dynamics in defining which (and whose) values come forward in forest governance.

[6] Under the voluntary conservation scheme, the forest owners permanently give up the right to do forestry in the relevant forest area, although hunting and harvesting of berries is still allowed.

3. Analytical frameworks and methods

In order to examine how different approaches to valuing and governing forest ecosystems can promote transformative changes toward sustainable community development, I used a triangulation of different analytical and methodological approaches. The main research strategy for the PhD project was developed during autumn 2019 and spring 2020, but the strategy was also refined and updated as part of an interactive process throughout the whole project (Maxwell, 2012). In this section, I describe my ontological position, the analytical frameworks, the research design, and the methods used for data gathering and analysis. Lastly, I reflect on aspects of research ethics, reliability, and limitations of the study.

3.1. Ontological and epistemological positioning

Any research project is situated within one or more research paradigms. Awareness of such positioning is an essential part of interpreting the process and the outcomes of the project. Maxwell writes that:

> the term paradigm, which derives from the work of the historian of science Thomas Kuhn, refers to a set of very general philosophical assumptions about the nature of the world (ontology) and how we can understand it (epistemology), assumptions that tend to be shared by researchers working in a specific field or tradition (Maxwell, 2012:223-224).

This PhD project has an ontological and epistemological positioning within institutional and ecological economics (Daly & Farley, 2011; Martinez-Alier & Muradian, 2015; Spash, 2017; Vatn, 2015) which has influenced the choices of research design.

Ecological economics conceptualize the relationship between society, nature, and economy fundamentally differently from neoclassical (orthodox) economics, including its branches, such as resource and environmental economics (Røpke, 2017; Vatn, 2015). One such ontological divide is found in how neoclassical economics and ecological economics conceive the relationship between ecology and economy. While neoclassical economics understand ecology (nature) as external to the economic system, ecological economics see ecology, society, and the economy as fundamentally interconnected (Costanza, 2001; Daly & Farley, 2011; Georgescu-Roegen, 2011; Martinez-Alier & Muradian, 2015; Røpke,

2017; Spash, 2017). Ecological economists hold that social and economic processes should be studied with concepts from natural sciences such as ecology and thermodynamics, as well as concepts from social science (Røpke, 2017). A key argument is that economic theory needs a paradigm shift from understanding ecological systems as more or less detached from the economic systems, to seeing the economy as deeply embedded in (a sub-system of) the ecology (Ingebrigtsen & Jakobsen, 2007; Raworth, 2017). This ontological assumption from ecological economics is illustrated in the embedded economy model (Raworth, 2017, see Figure 4), often also described as a "nested economy."

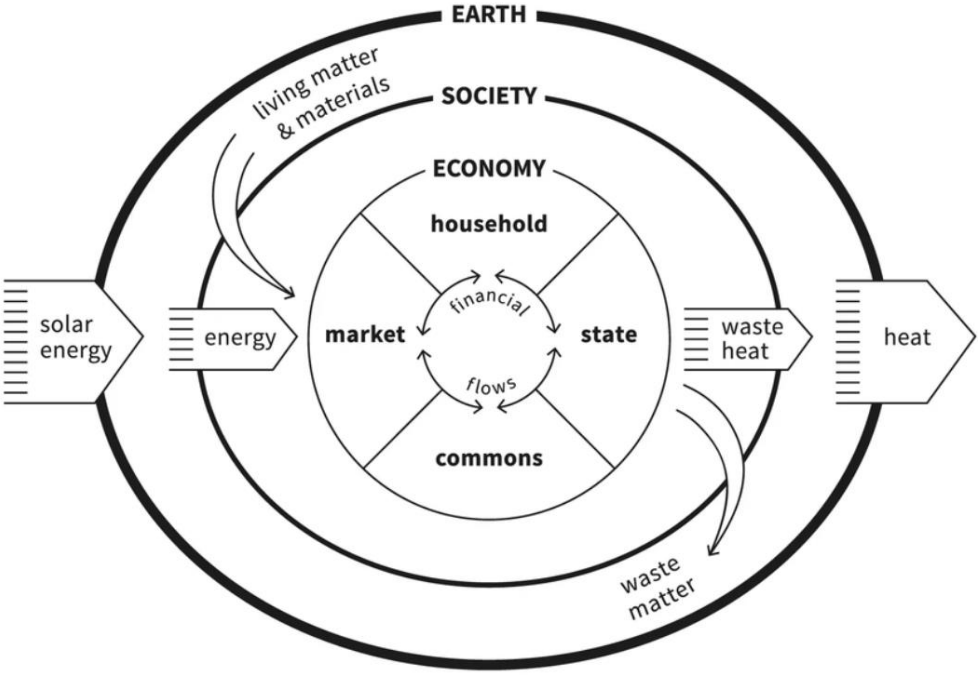

Figure 4: *The Embedded Economy, Credit Kate Raworth and Marcia Mihotich. CC-BY-SA 4.0, in Raworth (2017). The embedded economy model has roots in work by ecological economist such as Kenneth Boulding, Nicholas Georgescu-Roegen, and Herman Daly (1966; 2011; 1971)*

There are also significant differences in how neoclassical economics and classical institutional economics perceive human motivation and social reality. Vatn describes the "core" of the neoclassical economic model as i) rational choice as maximizing individual utility, ii) stable preference, and iii) equilibrium outcomes (Vatn, 2015:93). Classical

institutional economics challenges this "core" through its concern with institutions as social constructs, and as "constructing the human" (Vatn, 2015:102). Institutions are seen to "provide expectations, stability and meaning essential to human existence and coordination" (Vatn, 2015:78). Institutions also "support certain values, and produce and protect specific interests" (Vatn, 2015:78). From this perspective, preferences and values are not seen as "stable" and "given" but are inevitably also shaped by the cultural and institutional context. This means that institutions both affect the values that people hold, and the ways in which people perceive nature's values. In addition, valuation methods are themselves part of the institutional context, and the choice of methods can shape the results of any study (Arias-Arévalo et al., 2018; Gómez-Baggethun et al., 2014; IPBES, 2022a). This is e.g., captured in the term value-articulating institutions (VAIs), described in section 3.2.3 of the thesis. As an example, such VAIs can be seen as institutional structures, where "the choice of method defines the logic of the appraisal process and next influences the output" (Vatn, 2009:2207).

Institutional economist point to how dominating institutions in society are often designed to incentivize people to make choices to maximize individual utility – for example through private ownership of nature, or by framing peoples' primary societal role as consumers in a marked-based economy (Vatn, 2015). However, the institutional context can also be designed in ways that emphasizes peoples role as citizens, and as stewardess of common goods (see e.g., Soma & Vatn, 2010; Soma & Vatn, 2014)

3.2. Analytical frameworks

In this section, I give a more in-depth account of the four main analytical frameworks used for this research: i) ecosystem services capacity, flow, and demand, ii) typologies for *broad* and *specific* values, iii) the Environmental Governance Systems framework and VAIs, and iv) a typology of competing sustainability pathways.

3.2.1. Measuring ecosystem service trends: capacity, flow, and demand

In order to assess the trends and condition of forest ecosystem services, I draw on methodological approaches from recent assessments of trends ecosystem services (Berglihn & Gómez-Baggethun, 2021; Gómez-Baggethun et al., 2019; MEA, 2005), while adding a distinction between capacity, flow, and demand (Baró et al., 2016; Burkhard et

al., 2014; Villamagna et al., 2013). Ecosystem services capacity is defined here as "an ecosystem's potential to deliver services based on biophysical properties, social conditions, and ecological functions" (Villamagna et al., 2013:116), while the *flow* (or use) is defined as "the service actually received by people" (Villamagna et al., 2013:118). *Demand* (societal) is defined as "the amount of a service required or desired by society" (Villamagna et al., 2013:116), and I assessed societal demand with reference to national policy targets (Baró et al., 2016). The development of indicators to assess ecosystem service capacity, flow and demand is ongoing work, and I particularly aimed to contributed by filling knowledge gaps for measuring trends at a national level.

Baro (2016) draw on the distinction between capacity, flow, and demand to develop a framework for assessing "ecosystem services mismatches". As an example, if the use of one forest service is higher than forests capacity to provide this service, this can be defined as *unsustainable uptake*. In cases where ecosystem service demand is higher than the flow, there is *unsatisfied demand* (Baró et al., 2015).

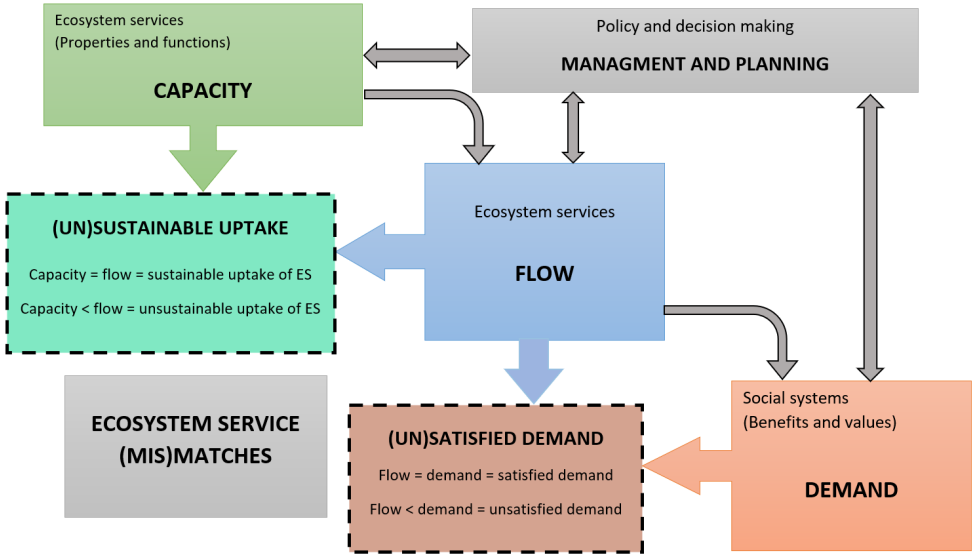

Figure 5: *Illustration of dynamics between ecosystem services capacity, flow, and demand. Adapted from Baro (2016), developed from Geijzendorffer et al. (2015); Potschin and Haines-Young (2011); Villamagna et al. (2013)*

3.2.2. Broad and specific values

The IPBES Values Assessment state that "the broad values that shape people's interactions with nature and with each other can align with sustainability when they emphasize principles like unity, responsibility, stewardship and justice" (2022a:XXIV). I used the categories of *broad* and *specific* values (described in section 2.2) to examine which values are promoted in Norwegian forest governance (Article 3). In the discussion of the thesis (Chapter 5), I use the term *core values* when referring to what IPBES defines as *broad values,* as I find the term *core values* to be more intuitive and pointed in communicating the type of values addressed.

With regards to specific values, I draw on the distinction between instrumental, intrinsic, and relational values. While *instrumental values* revolve around valuing nature as a means to an end, *intrinsic values* emphasize the value of nature in itself, independent of humans as valuers (ibid.). Relational values are defined as "the meaningfulness of people nature interactions, and interactions among people (including across generations) through nature (e.g., sense of place, spirituality, care, reciprocity)" (IPBES, 2022b:10). The classification of *specific values* resonates with other value classifications used in the ecosystem service literature, such economic, cultural, and ecological values (Gómez-Baggethun et al., 2014), but is not identical. The category of *instrumental values* is for example broader than that of *economic values.*

3.2.3. The Environmental Governance Systems framework and value-articulating institutions

I use the Environmental Governance Systems (EGS) framework (Vatn, 2015:154, see Figure 5) to study the role of institutions and power dynamics in defining which (and whose) values are promoted in forest governance. Although the EGS framework draws inspiration from Ostrom's SES framework for analyzing the sustainability of complex socio-ecological systems (Ostrom, 2009b), it more specifically delineates the role of different actors related to recourse regimes, political institutions, access/rights, and rules of interaction.

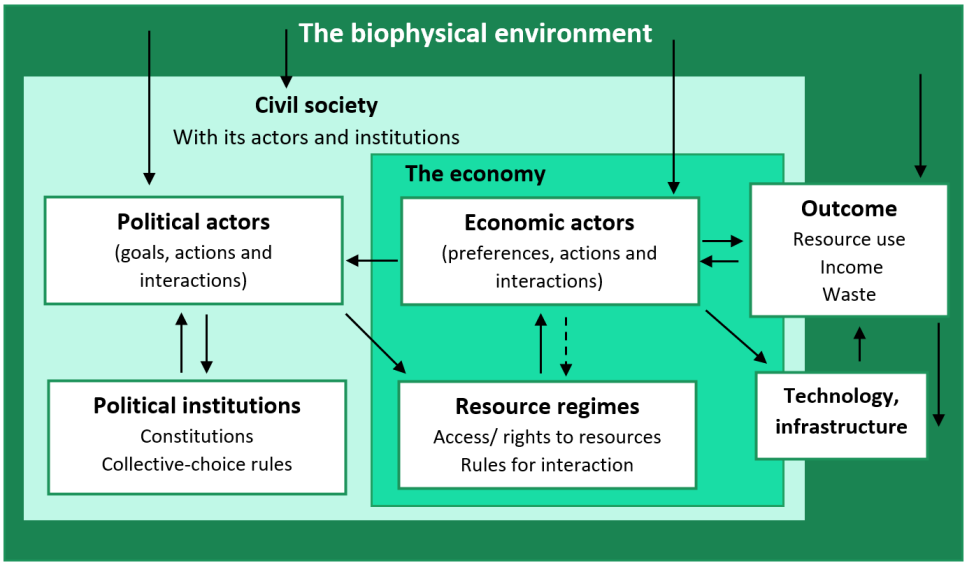

Figure 6: *Integrated framework illustrating the interaction between ecological, political, and economic processes (Vatn, 2021)*

The actor categories of the EGS framework illustrate "roles", that can be useful for analytical purposes (Vatn, 2015). Vatn defines the *economic actors* as those that hold rights to productive resources, such as forestry owners or forestry operators. *Political actors* are those that define the resource regimes and the rules for the political process, such as ministries or municipalities. Lastly, civil society is defined as "the arena for creating the normative basis of a society", while *civil society actors* are "the set of actors expressing the interest and will of citizens" (Vatn, 2015:144). The civil society has the power to legitimize or disapprove of the choices of political actors (Vatn, 2015:143). In addition to the "general citizen", there exist more formalized groups of civil society actors such as NGOs, mass media, university and research institutes, political parties, and organizations representing business. There are overlaps between the actor groups, and the same person can simultaneously belong to groups of political, economic, and civil society actors.

Political institutions and resource regimes frame the interaction between actors and have important implications for the *outcome*, such as trends and the condition of forest ecosystem services.

Overall, the EGS framework provides a useful analytical tool to assess power dimensions and value asymmetries in environmental governance. The IPBES Values Assessment brings attention to the role of power in deciding which values, and whose values, are acknowledged and integrated in decision-making (Martin et al., 2022). Assessing such power dimensions does not just entail a *one-dimensional* view of power, that focuses on observable behavior and decision-making (Vatn, 2015:86). It also entails a *two- and three-dimensional* view, including non-decision-making in terms of issues that are suppressed, and the power to form peoples interests and wants (ibid.). Vatn emphasizes that it is particularly difficult to study processes relating to the two- and three-dimensional views of power, as these power dimensions are found "not only in lack of action, but also in lack of awareness by the self – by the people whose interests have been perverted" (Vatn, 2015:87).

Institutional analysis through the EGS framework can bring awareness to issues that are suppressed and to the role of institutions in shaping people's wants. Of particular relevance here is the notion of value-articulating institutions (Vatn, 2015; Vatn, 2021) (see e.g., O'Neill & Spash, 2000). VAIs are defined here as "rule structures facilitating the articulation of values and interests" (Vatn, 2015:264). Such rule structures are for example found in specialized evaluation methods, such as cost-benefit analyses, multicriteria analysis, or deliberative methods. The concept of VAIs may also refer to the ways that values are embedded in rules guiding decision-making, such as the rules of markets. Overall, VAIs provide a rationality context and guidelines for how values should be articulated, aggregated, and traded against each other (Vatn, 2015:264).

I specifically use the actor categories of the EGS framework in Articles 2 and 3. In Article 3 I also use the notion of VAIs to examine the role of institutional arrangements and power dynamics in mobilizing or restraining ecosystem services and values in Norwegian forest governance.

3.2.4. Competing sustainability pathways

To assess how values and livelihood options associated with competing sustainability pathways are reflected in rural policies, I used the pathways typology introduced in the IPBES Values Assessment (IPBES, 2022a; Martin et al., 2022) as an analytical tool (see page 2, Introduction, and section 2.2). The IPBES typology delineates between four transformative pathways toward just and sustainable futures i) green economy, ii) degrowth, iii) earth stewardship, and iv) nature protection. The sustainability pathways draw inspiration from the Nature Futures Framework (Pereira et al., 2020). This framework consists of positive nature visions that where derived from an iterative and deliberative process in the period from 2016 to 2019. The vision of 'nature for nature' aligns with a *nature protection* pathway, 'nature for society' with *green economy*, and 'nature as culture' with *earth stewardship*. Furthermore, IPBES acknowledge *degrowth* as and additionally distinct pathway (Martin et al., 2022).

Although the term "green economy" is used in this typology, the concepts "green economy" and "green growth" is closely interlinked, and often conflated, in international research and policies (see e.g., Hickel & Kallis, 2020; Stoknes & Rockström, 2018). In my discussion, I therefore use the term 'green growth', as I believe that this term reflects a more clearly delineated set of sustainability values and policies.

The sustainability pathways differ with regard to which policies and values to emphasis in order to mobilize sustainability transformations (Martin et al., 2022; Pereira et al., 2020). As an example, the *green growth* pathway calls for instrumental values and technological innovation, while the *degrowth* pathway is concerned with egalitarianism, sufficiency, and local small-scale production. Furthermore, whereas the *earth stewardship* pathway emphasizes relational values and the importance of local and indigenous people as custodians of nature, the *nature protection* pathway is concerned with ecocentrism and intrinsic values and call for large, protected areas of nature (Martin et al., 2022; Pereira et al., 2020).

3.3. Methods

Here, I provide a general account of the research design, before providing more details of data gathering and methods in section 3.4. In my research design, I used a *triangulation* of different nature-based, behavior-based, and statement-based valuation approaches to study values and institutions of Norwegian forest governance. Key methods included multiple literature and documents reviews, in-depth interviews, and a survey. This plurality of methods enabled me to illuminate the problem statement and research questions from different perspectives, which may contribute to more reliable results (Maxwell, 2012).

3.3.1. Valuation approaches

Nature-based, behavior-based, and statement-based valuation are described as three of the four main "methods families" of valuation by the IPBES Values Assessment (IPBES, 2022b, main point B2). These families of methods all contribute to the fourth valuation family, namely *integrated valuation.* Table 1 gives an overview of how the different types of valuation approaches have inspired the different articles in this thesis.

Table 1: Valuation approaches used in the articles

Valuation-family	Application
Nature-based valuation	Articles 1 and 2
Behavior-based valuation	Articles 1 and 2
Statement-based valuation	Articles 3 and 4
Integrated valuation	

Article 1 draw inspiration from a *nature-based valuation* approach to assess trends in forests *capacity* to provide different ecosystem services from 1950 to 2020. Such nature-based valuation "measures or analyses information about the properties of nature and its contributions to people, and may be used to assess ecological integrity and to identify and quantify nature's contributions to people" (IPBES, 2022b:15). By assessing statistics on trends in *use (flow)* of forest ecosystem services, and assessing the direct drivers of change, the first article also applies a *behavior-based valuation* approach. This type of valuation "relies on observing what people do and the choices they make" (IPBES, 2022b:15).

Drawing on results from the biophysical assessment of forests capacity for ecosystem services, Article 2 uses a *behavior-based valuation* approach to examine the role of economic instruments in ecosystem service tradeoffs. Here, information on the targeted ecosystem services and monetary flows of each economic instrument is used to measure the importance attribute to forest ecosystem services in markets, or through government expenditure.

Next, Articles 3 and 4 draw on statement-based valuation methods to assess i) social preferences for forest ecosystem services and values, and ii) how values associated with competing sustainability pathways are reflected in people's sustainability conceptions. Statement-based valuation is signified by using "people's expressions of their relations to nature to deduce the importance of nature for people as well as their preferences" (IPBES, 2022b:15). IPBES holds that this type of valuation is well suited to producing knowledge about "the different worldviews and motivations underlying peoples' reasons for valuing nature in terms of supporting their quality of life" (IPBES, 2022b:15).

The use of specific methods in Article 3 and 4 was significantly affected by Covid restrictions; section 3.3.2 explains the corresponding changes made to the research design.

Lastly, I aimed to contribute to an *integrated valuation* of Norwegian forest ecosystems, by combining "different sources of information on nature's values" and elucidating "connections between different types of values" (IPBES, 2022b:15). Such integrated valuation is here defined as "the process of synthesizing relevant sources of knowledge and information to elicit the various ways in which people conceptualize and appraise ecosystems services values, resulting in different valuation frames that are the basis for informed deliberation, agreement and decision" (Gómez-Baggethun et al., 2014:20).

My intention was to combine insights on the values that people hold and assign to forests, with the ways in which values are embedded in institutions, to inform a broad conversation on how different approaches to valuing and governing forest ecosystems can promote transformative changes toward sustainable community development.

3.3.2. Changes in research design

As I aimed to examine values and voices that were potentially suppressed in decision-making, it was relevant to search for the voices that are not typically represented in Norwegian forest governance. As opposed to a more traditional "stakeholder assessment", I wanted to access perceptions of local people broadly, as citizens. The initial research design of the PhD project included approaches to elicit values held by rural inhabitants through participatory scenario-workshops. My aim was to do fieldwork in selected local communities and use methodological approaches such as participatory observation and focus group interviews to gain a deeper understanding of the values that people held, and the values they attributed to forests. Next, I aimed to design local scenario workshop for deliberating forest values and co-creating knowledge about the role of forests in sustainability transformations. A core aim of such workshops was to examine whether responses from economic, political, and civil society actors shifted if the deliberative process was designed to either emphasize participants' role as competing *stakeholders*, or to emphasize their role as *citizens* (Soma & Vatn, 2010; Soma & Vatn, 2014).

However, just as I was about to begin fieldwork in March 2020, Covid lockdowns were imposed in Norway (and worldwide). To varying degrees, Covid-related restrictions lasted for almost two years, before the last restrictions were lifted in winter/spring of 2022. During this period, restrictions included strict regulations on traveling and meeting with people physically. Overall, the Covid-restrictions prevented my original plans of gathering people in rural municipalities for scenario workshops and focus groups. The research strategy was consequently redesigned to adhere to available data sources.

When it was not possible to elicit citizens perceptions and values qualitatively through the planned workshops, I turned to scale through a survey. I worked to frame the survey toward mobilizing people as citizens, while also making it possible to distinguish different "actor roles" (see details on the survey design in section 3.4.3). Although this shift in the research design gave me less in-depth, qualitative data, it enabled access to the perceptions of many more people than originally planned. Following these changes in the research design, Article 3 examine social preferences for forest ecosystem services and values broadly, while the Article 4 elicits how values are reflected in people's conceptions of sustainability and their wishes for future livelihoods.

The research design, and specifically the design of the survey, was inspired by typologies of instrumental, intrinsic, and relational values (Arias-Arévalo et al., 2017; Arias-Arévalo et al., 2018; IPBES, 2022a; Pascual et al., 2017). I also drew inspiration from the two distinct economic mindsets of *green growth* and *degrowth*, which have long been contrasted in scientific debates (D'Alisa et al., 2014; D'Alessandro et al., 2020; Escobar, 2015; Georgescu-Roegen, 2011; Hickel, 2020; Hickel & Kallis, 2020; Jackson & Victor, 2019; Kallis et al., 2020; O'Neill, 2020; Stoknes & Rockström, 2018). However, the launch of the IPBES Values Assessment in summer 2022 was of great importance to the last refinements of the research design and analysis of the collected data. With its comprehensive state-of-the-art overview on valuation approaches globally, the assessment gave me new insights with which to analyze the results in more innovative ways. As an example, I emphasized the distinction between broad values underpinning the more specific forest values in the analysis of data material for Article 3, while the delineation of the four competing sustainability pathways inspired the data analysis in Article 4.

3.4. Data gathering and analysis

Articles 1 and 2 uses secondary data from literature and policy review. Articles 3 and 4 draw largely on empirical data collected from in-depth interviews (N = 15) and a survey distributed to inhabitants in 12 municipalities (N = 3591), combined with policy reviews. I combine the description of data gathering and analysis within each of the following subsections, through first explaining which data that was collected, and how, and then describing how this specific data material was analyzed.

3.4.1. Literature and policy reviews

Reviews of official statistics and national and local policy documents contributed substantially to the data collection for all four of the articles.

To assess trends in forest ecosystem services for the first article, I conducted a comprehensive review of policy documents, historical literature (including gray literature), and statistics. Sources of particular importance were official statistics from Statistics Norway, and a national data base on Norwegian forestry, compiled by the Norwegian Institute of Bioeconomy Research [NIBIO] (Tomter & Dalen, 2018). The paper also draws on previous mapping of Norwegian forest ecosystem services (Berglihn & Gómez-Baggethun, 2021; Lindhjem & Magnussen, 2012; NOU 2013:10, 2013). The first stage of the review consisted of a broad assessment of trends in Norwegian forest governance and of identifying the most important forest ecosystem services. For the data analysis, I did a biophysical assessment of the selected services, using specified indicators for measuring trends in capacity, flow, and demand, and to identify important drivers of change.

To examine the role of economic instruments in ecosystem services tradeoffs, the second article reviewed official data from the Norwegian Agricultural Agency (NAA, 2023a; NAA, 2023b), the fiscal budget of the Ministry of Climate and Environment and the Ministry of Agriculture and Food (2022) (MAF, 2022; MCE, 2021), and different forestry certification schemes (Tomter, 2023). The documents were analyzed according to specified criteria to identify targeted ecosystem services and monetary flows. Previous assessment of economic instruments in Norwegian environmental governance (Kvakkestad et al., 2012; Magnussen et al., 2020; NOU 2013:10, 2013) was used to inform and validate results in the article.

The third article uses a review of national policy documents to identify the main VAIs and assess how these VAIs mobilize or restrain different forest values and ecosystem services. The documents were analyzed according to key criteria defining VAIs such as: i) who gets to participate (in which capacity or actor role); ii) what defines the process; iii) how are values expected to be expressed; and iv) which forms do recommendations and conclusion take (Vatn, 2021:185).

The fourth article reviewed national (N = 3) and local (N = 12) policy documents that guide rural development, to assess how values and livelihood options associated with competing sustainability pathways are reflected in rural policies. For this analysis, I drew on the IPBES Values Assessment (Martin et al., 2022) and international literature to develop a typology of indicators and descriptors that signified four competing sustainability pathways. Next, I examined how the policy documents engaged with descriptors and indicators associated with each pathway.

3.4.2. In-depth interviews

During 2021, I carried out in-depth interviews with 13 forest experts and two municipal representatives working with forest governance. Informants were identified in cooperation with Håkon Aspøy, a PhD candidate working on the research project "Real-world ecosystem management: Identifying knowledge gaps and overcoming societal barriers" (ECOREAL). We cooperated on the development of a semi-structured interview guide that covered data needs for both of our PhD projects (see Appendix A, Table A.1), and we undertook most of the interviews together.

The main aim of the interviews was to gain broad knowledge concerning the issues of Norwegian forest governance. For my PhD project, I was particularly interested in the informants' perceptions about i) how forest values contribute to sustainable community development in Norway, ii) how forest values are integrated into decision-making, and iii) the role of citizens in Norwegian forest governance. The informants for the digital interviews (N = 13) were knowledge producers working in research institutes/universities, or within education (i.e., actors from the formalized part of civil society). We aimed for a mix of informants with primary connection to either the environmental segment (N = 4), the forestry segment (N = 4), or both combined (N = 5).

We invited the interview informants with a letter of consent (see Appendix A.2). This letter outlined the content of the ECOREAL project and the PhD project, explained the process of data storage, and detailed the rights of the informants. At the start of each interview, we repeated key information from the letter, and asked whether informants preferred to stay anonymous. We also asked for their consent to record the interview, for later transcription. Most of the interviews lasted between 1 to 1 ½ hours each. Our experience was that doing the interviews digitally did not affect the interview situation negatively. Rather, the context of the informants being in their home-offices seemed to contribute to a relaxed atmosphere in which the informants freely shared their views and experiences.

Once the Covid situation allowed, I also conducted two field interviews with representatives from Oslo and Sør-Aurdal municipalities. Oslo is the capital of Norway, and the municipality owns and manages large forest properties. In Oslo, we visited a forest area where continuous forest cover (closed timber harvest) is used as a management approach to promote biodiversity and recreation. During the field visit in the rural municipality of Sør-Aurdal, I met with both a municipal representative (political actor), and a forest owner (economic actor).

All of the interviews were later transcribed, and I used data from the interviews to frame the survey during summer and autumn 2021, and for data analysis in Article 3.

3.4.3. Survey: quantitative and qualitative analysis

During summer and autumn 2021, I worked together with my employer, the Norwegian Centre for Competence on Rural Development (NCCRD),[7] a national reference group (N = 11), and representatives from eight rural municipalities to design a survey aimed at fulfilling the multiple purposes of i) eliciting citizens' forest values and conceptions of sustainable development, ii) producing knowledge for national policy development, and iii) providing specific insights for local sustainability planning. The national reference group consisted of representatives from regional authorities (such as different county

[7] The Norwegian Centre for Competence on Rural Development is a professionally independent government agency subsidiary to The Ministry of Local Government and Regional Development, funded through the National Budget. The center works to strengthen Norwegian rural municipalities and regions' ability to develop attractive communities (NCCRD, 2023).

councils), and national actors (including the Norwegian Association of Local and Regional Authorities and the Ministry of Local Development and Regional Planning).

The eight rural municipalities of Bykle, Fjaler, Solund, Hyllestad Vega, Vang, Lebesby and Askvoll were selected for the study based on representing a mix of nature types and typography, as well as their varied experiences with local sustainability work. With regard to forest ecosystems and forestry, these eight municipalities represent a varied mix – ranging from having very scarce forest areas (such as Vega and Solund), to having a relatively large share of the municipality covered by forest (such as Fjaler and Hyllestad). During winter 2021–22, we extended the sample to also include Grue, Sør-Aurdal, Engerdal, and Rendalen municipalities. These four municipalities, all located in Innlandet County, are typical forest communities with large forest areas and active forestry.[8] Table 2 gives an overview of the population number and size of forest areas in the different municipalities, while Figure 7 provides an overview of the sample municipalities, sorted by the Norwegian Rurality Index.

Table 2. Overview of population and share of forest area in each sample municipality, southern Norway, 2021-22

	Forest, percentage of unbuilt land area	Forest, km² of unbuilt land area	Total km² of unbuilt land area	Population in 2022
Solund	**7.6%**	17.14	225.22	768
Vega	**8.5%**	13.67	159.92	1219
Lebesby	**9.5%**	330.65	3454.97	1226
Vang	**12.3%**	184.45	1495.45	1310
Bykle	**17.2%**	250.48	1456.89	935
Askvoll	**22%**	70.64	320.51	2951
Fjaler	**48%**	197.22	409.87	2901
Engerdal	**48%**	1 048.23	2184.56	1253
Hyllestad	**53%**	134.55	253.86	1290
Rendalen	**54.9%**	1734.75	3160.54	1722
Sør-Aurdal	**71.4%**	777.86	1089.01	2889
Grue	**80.5%**	658.59	817.86	4548

Source: (SSB, 2023b)

[8] Engerdal has somewhat less active forestry than the other three "forest communities" (SSB, 2023), as explained in-depth in the grouping of municipalities in Article 3.

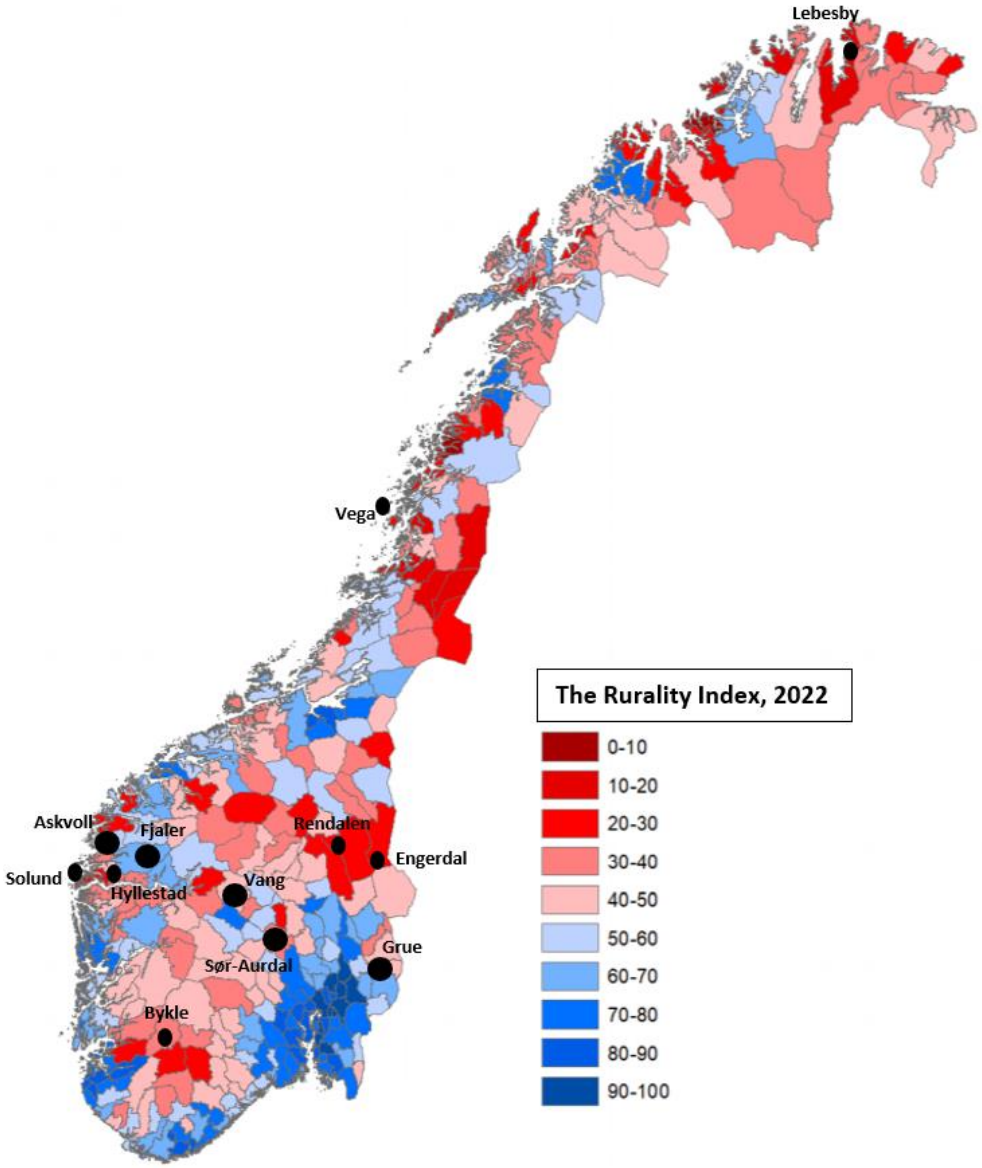

Figure 7: *Geographical overview of the sample municipalities, sorted by the Rurality Index (KMD, 2022). Sample size indicated as small (small circle) or relatively large (bigger circle). The "Rurality Index" illustrate the municipalities that are seen as the most rural (from dark red = very rural, to dark blue = urban/city). Criteria for assessing degree of rurality include: i) centrality (40%), ii) population growth over the last 10 years (40%), iii) growth of employment rate over the last 10 years (10%), and iv) vulnerability of the local business composition (10%) (MLGRD, 2023)*

Background variables collected through the survey included: i) age, ii) gender, iii) years living in the municipality, iv) land-ownership status, v) education, and vi) income level. Moreover, the survey consisted of a combination of closed questions, and open questions to be answered in writing. The closed questions had choices on a 5-step scale: i) agree, ii) partially agree, iii) neutral, iv) partially disagree, v) disagree. Answers to the closed questions were mandatory in order to complete the survey, whereas the open questions were optional (see Appendix A.3 for overview of the general closed questions used for this research). Open questions included: "What does the concept of sustainable development entail to you?" and "What type of livelihoods do you think the municipality should focus on in the future?"

In ten of the municipalities, the survey also included a section aimed at eliciting citizens preferences for forest ecosystem services and values.[9] Following the question: "In which way is the forest in the municipality most important to you and your local community?" respondents were asked to grade the importance of nine ecosystem services, on a scale from 1 (not important) to 5 (very important) (see Table 3). Respondents were also given the optional open question: *"Do you have other thoughts on the importance on forest for you and your local community?"*

The survey was distributed online by the municipality administration, between November 2021 and March 2022. Participation was open to all inhabitants based on self-selection. Some municipalities also invited part-time inhabitants to respond, such as those owning a recreational home in the municipality. No compensation was given for participating in the survey, and participation was anonymous (no personal information or IP-addresses were collected). NCCRD was responsible for the data collection and storage. Data sets from the closed questions of the eight initial municipalities that participated in the survey was made publicly available on NCCRD's web page, and through different reports (Skavhaug et al., 2022; NCCRD, 2022a; NCCRD, 2022b).

[9] As a result of being coastal communities with very scarce forest areas, Vega and Lebesby municipalities chose to exclude the forest-related questions from the survey among their population.

In terms of analysis of the survey data, Article 3 conducts a *quantitative analysis* of the answers to the closed survey questions, while Article 4 conducts a *qualitative analysis* of written answers to the open questions.

For the *quantitative analysis,* I used the open-sourced statistics program Jasp (2023). The analysis consisted of four main steps: i) retrieving descriptive statistics (including mean and standard deviation), ii) analysis of variance (ANOVA) with Post-Hoc tests to compare results across different socio-demographic characteristics, and retrieve P-value (statistical significance), iii) an exploratory factor analysis to elicit the relationship between broad and specific values, and iv) a regression to examine correlations between appreciation of ecosystem services and factors identified in the factor analysis. For the quantitative analysis, I only used the replies from the ten municipalities that replied to the forest questions. Moreover, I excluded replies from respondents who did not complete the whole survey, which left a total of 1694 respondents.

In the analysis of importance attributed to forest, I combined the four main categories of ecosystem services (supporting, cultural, provisioning, and regulating) (MEA, 2005; TEEB, 2010) with the classification of instrumental, intrinsic, or relational values (Arias-Arévalo et al., 2017; IPBES, 2022a) (Table 3).

Table 3: Categorization of forest ecosystem services in the survey

Type of forest ecosystem service	Ecosystem service category	Specific values
Home for animals and biodiversity	Supporting	Intrinsic
Inspiration for arts, culture, and literature	Cultural	Relational
Spiritual values	Cultural	Relational
Aesthetic (the landscape brings joy)	Cultural	Relational (instrumental)
Outdoor recreation	Cultural	Relational (instrumental)
Harvesting of berries, mushrooms, and wild plants	Provisioning (cultural)	Instrumental (relational)
Access to hunting and game resources	Provisioning (cultural)	Instrumental (relational)
Harvesting of timber	Provisioning	Instrumental
Sequestration and storage of carbon	Regulating	Instrumental (intrinsic)

Adaptation of table used in Article 3 (Helseth et al., under review). The secondary relation of each service to type of value is indicated in parentheses

For Article 4, I did a *qualitative analysis* of written answers to the two open questions "What does the concept of sustainable development entail for you?" and "What type of livelihoods do you think the municipality should focus on in the future?" For this analysis, I used the written replies from all the survey respondents, including those who only completed parts of the survey (N = 3591) as this provided richer data material. Here, I first used and inductive approach where I read all of the written replies, before specifying categories that reflected the sustainability conceptions and livelihood wishes most saliently expressed by the respondents, and then sorting all the replies into one of these main categories. I also developed a filter (based on descriptors of the different sustainability pathways) that enabled me to identify supporters of a green growth or a degrowth pathway, and to compare replies across these specific groups of respondents.

3.4.4. Workshop and dialog seminar

On 27 May 2021, I led a digital expert workshop (N = 19) on forest ecosystem services. The main aim of the workshop was to validate and revise preliminary results for the first article, and I invited selected forest experts from different institutions and disciplinary backgrounds, including ecologists, economists, and social scientists (see invitation letter in Appendix A.5). In the first part of the workshop, I presented details on methodology, selected indicators, and preliminary results, before participants were divided into four working groups according to their expertise with main ecosystem services categories. The aim of the working groups was to provide feedback on trends of capacity and flow for the main ecosystem service of each category. The last part of the workshop focused on drivers of change, and the experts were invited to conduct a qualitative assessment of how different drivers of change have affected the main categories of forest ecosystem services.

I also contributed to arranging a physical dialogue seminar (N = 33) about forest management practices on 30 May 2022. In this seminar, I presented preliminary results from Article 2, on ecosystem tradeoffs from economic instruments in Norwegian forest governance. The participants were later divided into five working groups to discuss these questions: i) How extensive is the need for alternatives forest management practices? ii) Where are different forest management practices best suited? iii) What are the most important barriers to alternative forest management practices? and iv) What is needed to overcome these barriers? I also co-wrote a report from the seminar (Aspøy & Helseth,

2022) and I used the results to revise and adjust the research design and data for Article 2.

3.5. Research ethics, reliability, and validity

In this section, I reflect on i) data storage and ethical clearance, ii) representativity in the survey, iii) positionality and possible biases, and iv) reciprocity of informants.

The PhD project gathered and stored data from *interviews* following the guidelines of the Norwegian Centre for Research Data. This means that data is stored on a secure server owned by NINA, where recordings and transcribed interviews are kept separately. Moreover, data from the interviews will be deleted at the end of the ECOREAL project, except in cases were the informants approved of data being stored for future research. Although most interview respondents did not mind being identified, I did not use their identities in this study, as this was not a requirement for the PhD project. The Norwegian Centre for Competence of Rural Development was responsible for collection and storage of data associated with *the survey.* Because the NCCRD is a public government organization, and not a research institute, it does not report to the Norwegian Centre for Research Data; however, it does follow GDPR guidelines for collection and storage of data. NCCRD owns the survey data, and data from the closed questions was published both on the NCCRD webpage and on the municipal webpages (NCCRD, 2022a; NCCRD, 2022b). In this regard, the data was secondary data and not primary data collected only for this PhD project. However, we cooperated on the design of the survey (to serve multiple purposes, as described in 3.4.3) and respondents were informed that results would be used in the PhD project. I discussed issues of ethical clearance with both NMBU and the Norwegian Centre for Research Data during the design of the survey, to clarify whether any extra steps should be taken. They confirmed that because the survey was anonymous, and owned by NCCRD, additional registration of data was not needed.

A core aim of the survey was to provide inputs for local development; therefore, it was important to the municipalities that the survey was open to all inhabitants. This required that the survey was not randomized. A weakness of this requirement may be that people who are interested in local development issues were more strongly represented among the respondents. We sought to minimize this bias by framing the survey as a broad inquiry about opinions on future development in the local community, in which all local views

mattered, and by encouraging the municipalities to spread the survey broadly among inhabitants.

With regards to my positionality, I have worked as a bureaucrat in the Norwegian public sector for the past 13 years. I first worked for five years as a climate adviser in a Norwegian county council, and then worked a year in a rural municipality in Western Norway before working for the NCCRD for the past seven years. The PhD project is a public sector PhD, and an important aim of the project is to contribute to public good and to provide practice-oriented knowledge to local and regional governments in Norway. My education is interdisciplinary, with a master's degree in *sustainability* from the Centre for Development and Environment at the University of Oslo, and an MBA in *ecological economics* from Nord University. Consequently, I have broad experience with issues of sustainable community development in Norway. However, at the start of the PhD-project, I had very little formal knowledge about Norwegian forests. Although my limited experience with forest governance may have been an initial weakness, I believe that my diverse background has also been a strength in terms of contributing with new perspectives to this field.

I used various strategies to attempt to balance possible biases related to my positionality in the academic fields of ecological economics and institutional economics, such as frequently consulting people with a variety of academic backgrounds and cross-checking both quantitative and qualitative analysis many times. First, I involved a broad set of actors in my PhD project and continuously asked for feedback on research design, methods, and preliminary results. I then cross-checked and validated results with colleagues, and with others (e.g., through the expert workshop and the dialog seminar). To reduce the risk of only getting feedback from people within my own academic field, I sought inputs from resource economists, environmental economists, ecologists, sociologist, historians, and scholars working with law. I frequently presented aspects of my PhD work at seminars at my institute, to my colleagues in NCCDR, in meetings arranged by the ECOREAL project and, not least, at three international research conferences: i) the ESP Europe conference "Ecosystem Services Science, Policy and Practice in the face of Global Changes", 7 to 10 June, 2021 (digital), ii) the ISEE-ESEE-DEGROWTH conference: "Building Alternative Livelihoods in times of ecological and

political crisis", 5 to 8 July 2021 (digital), and iii) the ESEE conference "Will Achilles catch up with the tortoise?, Pisa 14 to 17 June, 2022 (physical).

Second, during spring and autumn 2022, I spent months analyzing the survey data in multiple ways. My motivation was to understand in depth what the respondents wanted to communicate. This in-depth knowledge meant that I could quickly detect errors in the analysis I ran. I also compared and cross-checked results across many different samples, including each of the 12 municipalities. I was surprised (and reassured) by the similarities of the results, such as the ranking of different forest values and services, and the perceptions of general sustainability issues, which gave an indication of solid reliability in reflecting the views of rural people in Norway.

Third, when I worked with coding and analysis of the written responses to the open survey questions, I read through all of the 1331 individual answers at least three times, and sorted them in two separate rounds, to make sure that I would put them in the same categories each time. In cases where I noticed that I made different considerations in the second round of sorting, I stopped to consider why, and whether this was a result of biased assumptions, or if I needed to adjust something in the initial coding.

In terms of reciprocity to informants and respondents, I aim to share the results from the project in an accessible language. Main results of the project will be translated from English to Norwegian and made broadly available by the end of 2023. The project will also develop policy briefs for national policy development, as well as recommendations for approaches and methods that can be used by local communities in Norway (see Chapter 6 Conclusion).

4. Summary of articles

In this chapter, I give a short summary of the four papers of the PhD-thesis. The summaries correspond to the abstract of each paper (Helseth et al., 2022; Helseth et al., manuscript; Helseth et al., submitted; Helseth et al., under review), which provides a distilled presentation of main objectives, results, and conclusion. Lastly, Table 4 provides a summary of key components of all articles, and I use Figure 8 to illustrate how the articles of the PhD may contribute as leverage points for sustainability transformation (IPBES, 2022b).

4.1. Forest ecosystem services in Norway: trends, condition, and drivers of change (1950-2020)

Some regions like Europe have experienced a net gain in forest areas over the last decades, but intact areas of natural forests are declining worldwide, accompanied by changes in forest ecosystem functions and benefits to humans. We conduct a biophysical assessment of trends, condition, and drivers of change of forest ecosystem services in Norway from 1950 to 2020. Four main results are highlighted. First, industrial forestry, large scale measures of re- and afforestation, and infrastructure development (e.g., roads and recreational homes) have been the main direct drivers of forest transformation. Second, deep transformations in the Norwegian economy shaped trends of forest ecosystem services over the study period. Third, with the shifts toward the tertiary (service) sector and the mechanization of forestry, the economic and material relations between forests and local communities are waning. Overall, people's primary relationships to forests have shifted from livelihood to recreation. Fourth, forest management in Norway has largely favored provisioning services at the expense of supporting services and some cultural and regulating services. Consequently, while Norwegian forests retain strong capacity to deliver provisioning services, the overall ecological condition is relatively poor. Our assessment provides an approach to identify and explain trends of ecosystem services at a national scale, over a long period of time. We argue that growth in forest area and biomass are insufficient indicators for sustainable forest management, and that future forest polices would benefit from improved knowledge on forests ecological condition, resilience against climate change, and socio-cultural contributions to human well-being.

4.2. Unveiling imbalanced investments in forest ecosystem services

Economic instruments are increasingly used to promote different forest ecosystem services. Here, we use Norway as a case study to examine the role of economic instruments in stimulating forests capacity to supply different ecosystem service. Specifically, we i) map the most important economic instruments in Norwegian forest governance, targeted ecosystem services, and associated scales of investments, and ii) examine how existing economic instruments promote or constrain ecosystem services capacity. Data was collected from a review of policy documents and fiscal budgets, as well as from most recent data for status and trends of ecosystem services from Norwegian forests. Three main results are highlighted. First, the main economic instruments in Norwegian forest governance are markets for forest products and amenities, forestry certification schemes, and government expenditures such as subsidies for timber and payments for forest conservation. Second, markets for timber (578 mill €/y) and hunting licenses (74.1 mill €/y) amount to gross revenues of around 652.1 euros per year. Moreover, subsidies, tax reliefs, and PES-schemes primarily target habitat provision (43.44 mill €/y), timber (38.17 mill €/y), and carbon sequestration (2.53 mill €/y). Third, except for payments for voluntary forest conservation, most instruments target ecosystem services that forests already have increasing capacity to supply. By contrast, other services with declining or stable trends in capacity, such as sense of place and nutrient cycling, are sidelined, or even undermined by instruments targeting timber production and carbon sequestration. Our results suggest that regulation of markets, and major reallocation of investments and expenditures, will be required to diversify and balance capacity for supply of a broader array of forest ecosystem services.

4.3. Value asymmetries in Norwegian forest governance: The role of institutions and power dynamics

We draw on institutional and ecological economics to understand the role of social preferences, institutional arrangements, and power dynamics in mobilizing or restraining ecosystem services and values in Norwegian forest governance. Specifically, we i) elicit local people's preferences over forest ecosystem services and values, ii) analyze how perceptions of forest values vary across stakeholders, and iii) examine how participation is enabled by institutional arrangements. Our data were collected from a survey (N = 1694) distributed in 10 rural municipalities and from interviews with Norwegian forest experts and stakeholders (N = 15). Four results are highlighted. First, most respondents rank ecosystem services that embody relational and intrinsic values (such as recreation and biodiversity) higher than services that primarily embody instrumental values (timber). Second, women and non-forest owners show higher appreciation for relational values than men and forest owners. Third, dominant value-articulating institutions, such as timber markets and cost-benefit analysis, favor utility, efficiency, and instrumental values. Finally, few participatory arenas for decision-making are available, and local people do not feel empowered in forest governance. Our findings indicate that Norwegian forest governance primarily empowers actors that emphasize instrumental values followed by those who emphasize intrinsic values, whereas relational values tend to be restrained.

4.4. Beyond green growth: Mapping sustainability pathways for rural transformations in Norway

Competing sustainability pathways, such as green growth and degrowth, reflect different values and preferred solutions in response to the climate and environmental crisis. The recent Values Assessment by Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) states that mobilizing a diversity of sustainability-aligned values (such as care and reciprocity) are key to sustainability transformations. This paper examines the role of values and livelihood options as leverage points for rural sustainability transformations. Drawing on IPBES's analytical framework, we assess support to four different sustainability pathways in rural Norway: i) green growth, ii) degrowth, iii) earth stewardship, and iv) nature protection. Data was collected from an analysis of fifteen policy documents (N = 15) and a survey (N = 3591) distributed among local population in 12 Norwegian rural municipalities. Three main results are highlighted. First, green growth and associated values firmly dominate sustainability thinking in Norwegian policy agendas for rural development, followed by nature protection, and earth stewardship, while degrowth ideas are marginally represented. Second, while 17.5% of survey respondents describe profit or economic growth as key dimensions of sustainable development, one fourth (26.1%) emphasize nature protection, sufficiency, or local production. Finally, green growth supporters emphasize instrumental values and livelihood options based on tourism and industry, while degrowth supporters emphasize intrinsic and relational values through small-scale farming and resource use. Our results indicate that if Norwegian rural policy is to align with IPBES' recommendation to balance diverse values for sustainability transformations, policies should extend beyond green growth to incorporate a wider diversity of values, drawing on alternative sustainability pathways, such as nature protection, earth stewardship, and degrowth.

4.5. Overview of the articles

Table 4 provide a summary of articles, research questions, analytical approach, data collection, and key findings.

Through a biophysical assessment that addresses valuation and recognition of forest ecosystem service, Article 1 can be placed on the shallower side of leverage points for transformative changes (Figure 3) (IPBES, 2022b:37). However, through the assessment of indirect drivers, the article also documents how different societal goals have been driving trends in ecosystem service, which relate to some deeper leverage points, such as shifts in societal norms and goals. The second article assess the role of economic instruments in the differential promotion of ecosystem services, and what are the resulting tradeoffs, thereby relating to possible reforms of policies and regulations (medium leverage). The third article addresses the ways in which valuation in embedded in institutions and in decision-making processes and examines how value asymmetries may be balanced by redesigning institutions and by allowing for broader scope for citizen deliberation (deeper leverage). The last article addresses deep leverage points through an assessment of policy and popular support to competing sustainability pathways for rural Norway. This article directly addresses shifts in societal goals and discuss how sustainability-aligned values can be mobilized for sustainability transformations.

Table 4: Summary of articles, research questions, analytical approach, data collection, and key findings

Problem statement	Analytical approach	Data collection	Key findings
Article 1: Forest ecosystem services in Norway: trends, condition, and drivers of change (1950-2020) What are the trends, condition, and drivers of change of forest ecosystem services in Norway from 1950 to 2020?	Ecosystem service framework: capacity, flow, and demand Nature-based valuation (capacity) Behavior-based valuation (flow)	Review of policy documents, national statistics, and other literature (including gray literature)	Industrial forestry, large scale measures of re- and afforestation, and infrastructure development – combined with deep transformations in the Norwegian economy – shaped trends of forest ecosystem services from 1950 to 2020. Economic and material relations between forests and local communities are waning. Overall, forest management in Norway has largely favored provisioning services at the expense of supporting services and some cultural and regulating services. The article reveals a need for new and more diverse indicators for measuring sustainable forest governance.
Article 2: Unveiling imbalanced investments in forest ecosystem services In which ways do economic instruments in Norwegian forest governance promote or constrain forests capacity to provide different ecosystem services?	Ecosystem services framework: capacity Behaviour-based valuation (Importance attributed in markets and through government expenditure)	Review of fiscal budgets, certification, reports, markets	Prominent economic instruments in Norwegian forest governance are markets for provisioning and cultural services, forestry certification schemes, and state expenditures such as subsidies for timber and payments for forest conservation. Most instruments target services with increasing capacity. Ecosystem services showing declining or stable trends, are sidelined, or even undermined by subsidies for timber production and carbon sequestration. Results indicate a need for major shifts in government allocations to diversify forest ecosystem services.
Article 3: Value asymmetries in Norwegian forest governance: The role of institutions and power dynamics What is the role of social preferences, institutional arrangements, and power dynamics in mobilizing or restraining ecosystem services and values in Norwegian forest governance?	Statement-based valuation Quantitative analysis of replies to closed questions (factor analysis and regression) Institutional analyses of main VAI's	Survey among rural citizens In-depth interviews Literature review	Ecosystem services that embody relational and intrinsic values (such as recreation and biodiversity) are ranked higher than services that primarily embody instrumental values (timber). Women and non-forest owners show higher appreciation for relational values than men and forest owners. Dominating VAIs favor utility, efficiency, and instrumental values. Few participatory arenas for decision-making are available, and local people do not feel empowered in forest governance. Overall, there is a need for more deliberative arenas in forest governance that are suited to empower actors whose values are currently restrained.
Article 4: Beyond green growth: Mapping sustainability pathways for rural transformations in Norway How are values and livelihood options associated with competing sustainability pathways reflected in rural policies and in people's sustainability conceptions?	Competing sustainability pathways Statement-based valuation Qualitative assessment of written replies to open questions	Literature review of policy documents Survey among rural citizens	Green growth and associated values firmly dominate sustainability thinking in Norwegian policy agendas for rural development, followed by nature protection, and earth stewardship, while degrowth ideas are marginally represented. Green growth supporters advocate instrumental values and the safeguarding of resource for future (human) generations, while degrowth supporters emphasize intrinsic and relational values. There is a need to incorporate a wider diversity of values, drawing on alternative sustainability pathways, such as nature protection, earth stewardship, and degrowth.

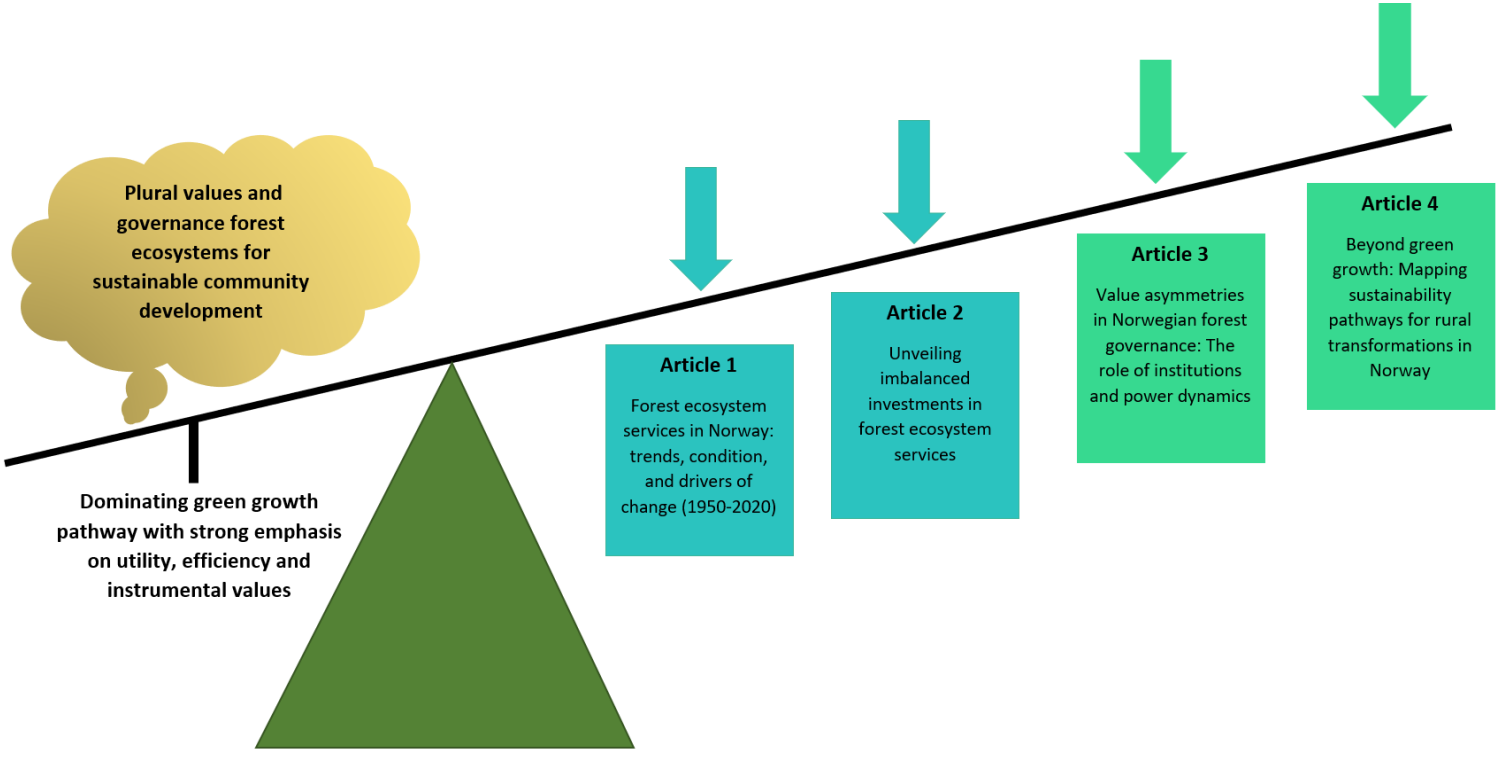

Figure 8: *The articles of the PhD as leverage points for sustainability transformation. Adapted from IPBES (2022b:37, see figure 2). The different articles of the PhD relate to the shallower and the deeper side of "leverage points", from ecosystem service assessment (relatively shallow leverage), to changing societal goals and sustainability pathways (deeper leverage)*

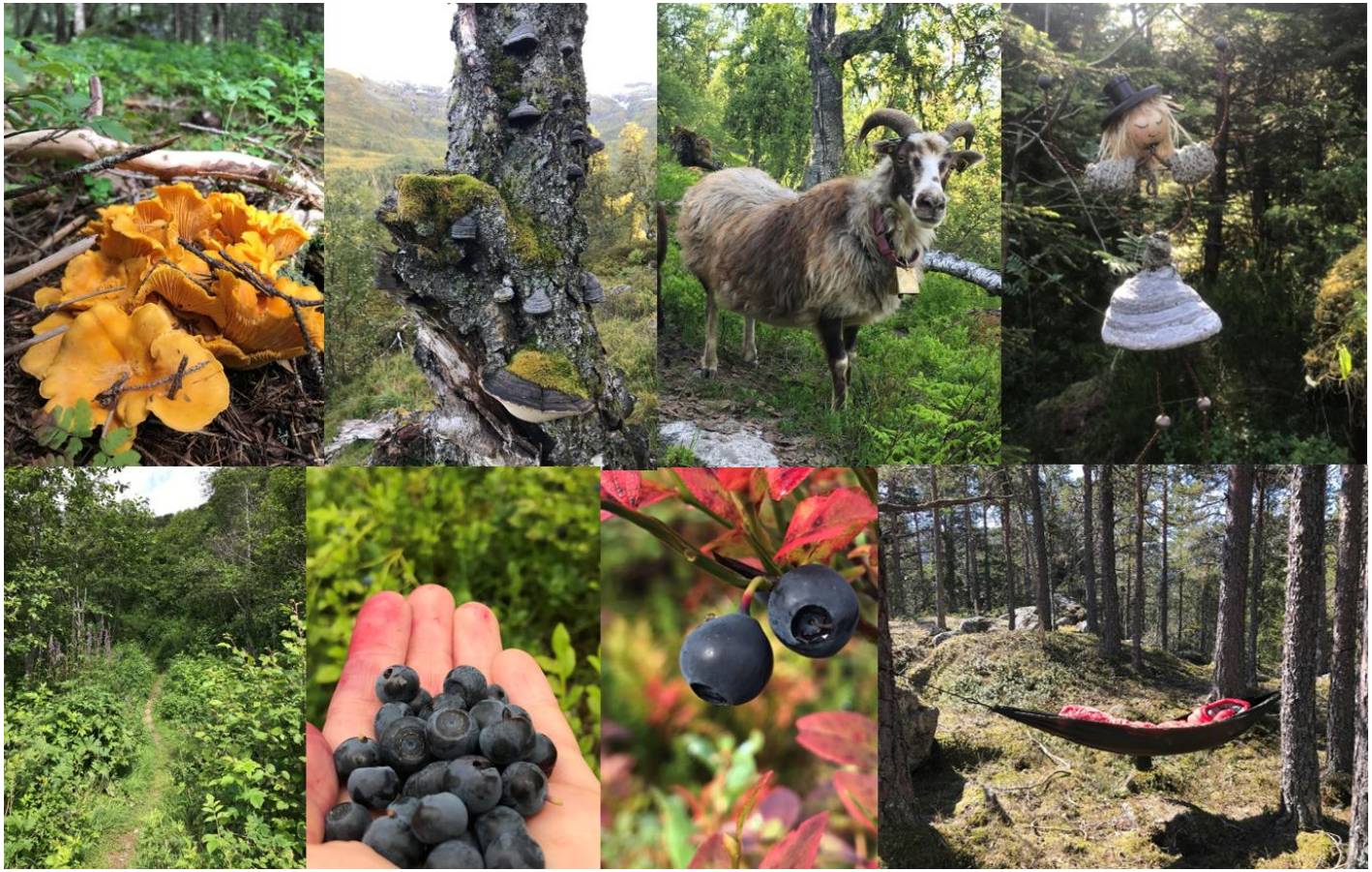

Image 1: *Illustration of diversity in ecosystem service and values from Norwegian forest; food (animals grazing, berries, and mushrooms), recreation, sense of place and belonging, carbon sequestration and storage, and habitat for biodiversity. Photos by Elisabeth V. Helseth*

Images 2 and 3: *Clear-felling for timber production, southern Norway, 2022. Photo by Elisabeth V. Helseth*

Image 4: *Forest area drained and planted with spruce in western Norway (tree species with natural habitat in this forest area is a mix of pine, birch, oak and holly). Photo by Elisabeth V. Helseth*

Image 5: *A forest area in Oslo, where Oslo municipality uses selective logging (continuous forest cover) as a forestry approach to promote recreation and biodiversity. Photo by Elisabeth V. Helseth*

Image 6: *Monument illustrating log driving, in which rivers were used to transport timber, e.g., to sawmills. Nordre Land. Photo by Elisabeth V. Helseth*

"When I walk in the forest in my home village, there are much less people in that forest - much less human activity - than it was when I was growing up 40 years ago. It's just that when that activity occurs, it becomes so pervasive"

(Norwegian forest expert (male) living in southeastern Norway, on changes in forestry practices, in-depth interview 2021, my translation).

5. Discussion

While the articles answers each of the four research questions of the thesis separately, this section integrate insights from the articles to inform the overall problem statement of the thesis: *how can different approaches to valuing and governing forest ecosystems promote transformative changes toward sustainable community development?* Here, I draw on the data material used in the articles, supplemented with data from the interviews and literature reviews.

In the first section, I discuss whether the imbalanced trends in forest ecosystem services in Norway can be seen as cost-shifting economic practices (Kapp, 1977; Martinez-Alier, 2003). Distinguishing between *core values* and *specific* values (IPBES, 2022a), I relate these trends to the *value monism of core values* that underpin both forest governance and rural policies in Norway. Next, advancing a typology of transformative pathways developed by IPBES, I argue that Norwegian forest governance is locked to a *green growth* sustainability pathway, which is being challenged by supporters of a *nature protection* pathway. Here, I reflect on the role of actors, institutions, and power dynamics in sustaining these two sustainability pathways. Lastly, I discuss how the deliberation of alternative sustainability pathways for forest governance may promote sustainability transformations.

5.1. Value monism and cost-shifting

The first article examines trends in forest ecosystem services, and drivers of changes (1950-2020). We find that growth in forest biomass occurred in parallel with fragmentation in forest ecosystems and changes in forest functions (Helseth et al., 2022). These trends in ecosystem services from Norwegian forests concur with fragmentation of forests in other European countries (see e.g., FAO, 2020a; Savilaakso et al., 2021), and they have important implications for forests contributions to people and communities (Helseth et al., 2022).

The most important indirect drivers of forest changes identified from our research were economic and socio-political. Shifts in Norwegian forest governance was strongly inspired by notions of modernity and scientific forestry (see e.g., Scott, 2008), conceiving of forests as a controllable resource to be shaped and utilized for economic development through

even-aged forest management with clear-felling (Bækkelund, 2020; Frivold, 2011). Economic growth was a key driver for infrastructure expansion such as the building of roads, power lines, and recreational homes that has fragmented forest areas (Helseth et al., 2022). Moreover, tertiarization of the economy and mechanization of timber production has contributed to shifting people's primary relation to forests from livelihood to recreation (ibid.). Overall, the assessment shows that provisioning services have been prioritized at the expense of supporting, regulating and cultural ecosystem services, and that tradeoffs across services have both contributed to biodiversity loss (Framstad et al., 2022; Lindhjem & Magnussen, 2012) and to loss of relational values, such as values associated with traditional livelihoods (Kaldal, 2022; SSB, 2015b).

Article 2 finds that the disproportionate focus of Norwegian forest governance toward promoting provisioning services is sustained by money flows directed to these services through markets and government expenditures (Helseth et al., manuscript). Examples include economic instruments targeting timber production (such as subsidies for forest roads), that simultaneously contribute to constrain capacity for ecosystem services that are in decline (such as habitat provision).

Articles 3 and 4 examine the role of institutions, power dynamics, and sustainability policies in mobilizing or restraining different values. In Article 3 we find that women and non-forest owners show higher appreciation for relational values than men and forest owners (Helseth et al., under review). However, although forest owners rank timber significantly higher than non-forest owners, they also rank biodiversity high (ibid.). Furthermore, these articles show that tradeoffs in favor of provisioning services are perpetrated by political and economic actors promoting intensive forestry and/ or infrastructure development, for example through value-articulating institutions that prioritize instrumental values, or by the *green growth* sustainability pathway that dominates Norwegian rural policies.

Combined, results from the articles indicate that the ecosystem service tradeoffs can be seen as practices benefiting economic actors, while simultaneously shifting costs to others, such as to other species and to the social actors that value these species. The survey results showing that citizens rank ecosystem services embodying relational and intrinsic values higher than those that primarily embody instrumental values (Helseth et

al., under review), indicate a mismatch between those values demanded by most people and the values that get priority in decision-making. This imbalance is underscored by the increasing societal demand for all forest ecosystem services (Helseth et al., 2022). As a poor ecological condition of forests will undermine the long-term capacity to provide ecosystem services and associated instrumental and relational values (IPBES, 2022a; MEA, 2005; TEEB, 2010), the imbalanced ecosystem service trends also signal cost-shifting to *future generations*.

Combined, the articles reveal that *core values* of utility and efficiency in Norwegian forest governance and rural policies are major underlying factors driving forest changes (Figure 9). Consequently, instrumental values are disproportionally promoted at the expense of nature's intrinsic value and of the relational values stemming from people's interaction with forests (Helseth et al., under review).

This lack of plurality of values can be defined as a situation of *value monism,* where diversity in services, values, livelihoods options, and species is at the losing end. By value monism, I here mean monism of *core values*. O'Neill focuses on such monism of *core values*, when he define "value monism" as "the view that there is only one kind of good that is valued for its own sake and is intrinsically valuable in this sense" (2017:229). Utilitarianism, which derives from the ethical tradition of consequentialism, perceive the good that is valued for its own sake as pleasure/ welfare (O'Neill, 2017; Vatn, 2015). Value monism relates to the idea of *commensurability,* as a philosophical underpinning of capitalism/ neoclassical economy, in which *pleasure/ welfare,* defined as maximization of *utility,* is the ultimate good to which everything else is measured. John Stuart Mill, one of the most outstanding classical utilitarianists, makes a clear case for commensurability:

> "There must be some standard to determine the goodness and badness, absolute and comparative, of ends, or objects of desire. And whatever that standard is, there can be but one; for if there were several ultimate principles of conduct, the same conduct might be approved of by one of those principles and condemned by another; and there would be needed some more general principle, as umpire between them (Mill 1884, bk 6, ch.12 §7)" (cited in O'Neill et al., 2008:112).

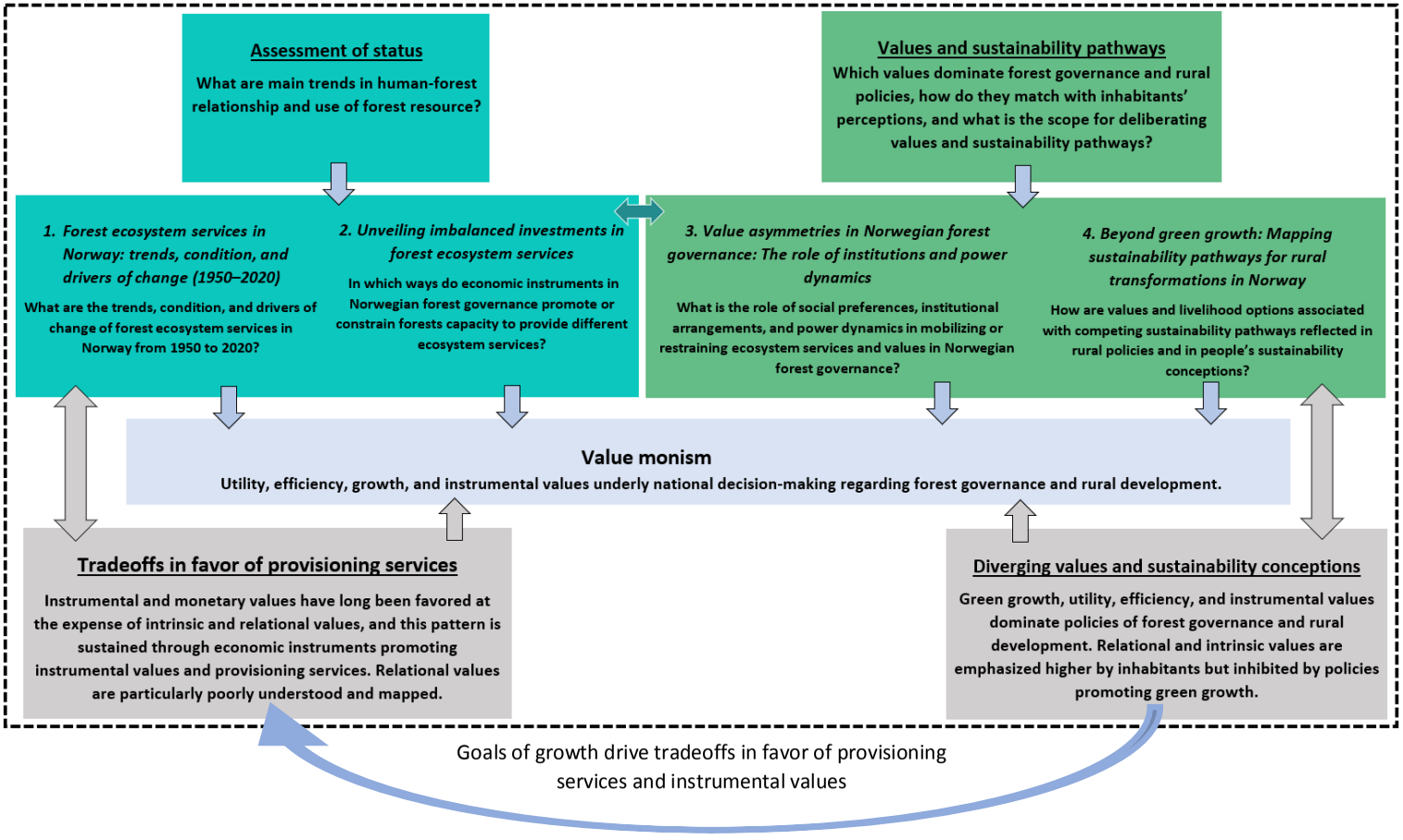

Figure 9: *Illustration of the relationship between results of the four articles*

Defending *incommensurability* of core values associated with other ethical traditions, such as *deontology* and *virtue ethics*, O'Neill argues that *value pluralism* is "the view that there are a number of distinct intrinsically valuable goods, such as autonomy, knowledge, justice, equality and beauty which are irreducible either to each other or to some other ultimate value" (2017:229).

Overall, I find that Norwegian forest governance has a normative positioning within a utilitarian tradition associated with capitalism/ neoclassical economy. My results indicate that allowing for deliberation of a broader set of *core values*, such as care and justice, may be needed to achieve balanced governance of *specific values* in Norwegian forest governance, such as relational and intrinsic values. The results also indicate a need for sustainability pathways with different ethical underpinnings than neoclassical economy, which is elaborated in the following.

5.2. Dominating pathways and power dynamics in Norwegian forest governance

The IPBES Values Assessment holds that the plural values associated with different sustainability pathways should be mobilized to promote sustainability transformations (IPBES, 2022a; Martin et al., 2022). From the assessment of sustainability pathways in rural Norway, we find that a *green growth* pathway heavily dominates rural policies agendas, followed by *nature protection* and *earth stewardship*. Values and practices associated with a *degrowth* sustainability pathway are only marginally represented in rural policies, for example in calls for reduced levels of consumption (Helseth et al., submitted). In this section I discuss how these sustainability pathways are reflected in Norwegian forest governance and how the pathways promote different approaches to valuing and governing forests.

Combined, the literature reviews and interviews indicate that the *bioeconomy* discourse that has gained traction in Norwegian forest governance in recent years strongly promotes a *green growth* sustainability pathway (Burton et al., 2020; Krøgli et al., 2020; The Norwegian Government, 2016). The broad values associated with this *green growth*

pathway include utility and efficiency, while specific values are instrumental and monetary. This pathway calls for sustained growth in forest biomass and increased harvest level, to secure the supply of renewable materials and energy, and carbon sequestration, toward an envisioned 'green shift' (ibid.). According to supporters of this pathway, even-aged management with clear-felling should remain a hegemonic practice, while alternative forest management practices are not seen as efficient enough (see e.g., Aspøy & Helseth, 2022). Moreover, there is an emphasis on continued technological development, increased competitiveness within forestry and the wood-processing industry, and continued infrastructure expansion (such as forest roads) to access timber resources more efficiently (MAF, 2016).

This green growth pathway is a continuation of the forest policies that have dominated Norwegian forest governance over the past 70 years. In this regard, it is not *transformative* in terms of the call for "fundamental, system-wide reorganisation across technological, economic and social factors, including paradigms, goals and values" (IPBES, 2022a:544).

This *green growth* rationale has long been challenged by supporters of a *nature* (*forest) protection* pathway. Forest protection is today advocated by nature conservation organization such as the Norwegian Society for the Conservation of Nature, WWF, and Sabima, and backed by organizations that front outdoor recreation, such as the Norwegian Trekking Association (Olerud et al., 2022). Early notions of nature protection in Norway (including forests) date back to the 1800s. As the ecological costs of intensive forestry and infrastructure sprawl became more apparent during the 1970-80s, nature protection supporters advocated the importance of intrinsic and ecological values (Framstad et al., 2017; Hoen et al., 2019). A systematic protection of Norwegian forests developed from around the 1980's (Framstad et al., 2017; Ministry of Environment, 1980), while the specific emphasis on biodiversity protection increased from 2000 and onwards (Framstad et al., 2017; Frivillig Vern, 2022). The broad values associated with this nature protection pathway include responsibility and solidarity across species, while emphasis is given to the intrinsic value of nature. Moreover, supporters of the nature protection pathway have strongly contributed to developing the ecological knowledge that is today used to measure and communicate the Norwegian Nature Index and the ecological condition of Norwegian forests (see e.g., Aslaksen et al., 2015; Certain & Skarpaas, 2010;

Certain et al., 2011; Framstad et al., 2022; Framstad E (red.), 2015; Spash & Aslaksen, 2015).

These two competing sustainability pathways are today reflected in different *segments* of Norwegian forest governance (Aspøy & Stokland, 2022). On the one hand, political actors and civil society actors advocating a *nature protection* pathway (such as NGO's and environmental ministry and agencies) unite in a narrative of *crisis in biodiversity loss* in forests. On the other hand, civil society, political and economic actors advocating a *green growth* pathway, promote a narrative of *success in growing biomass* (see Figure 10).

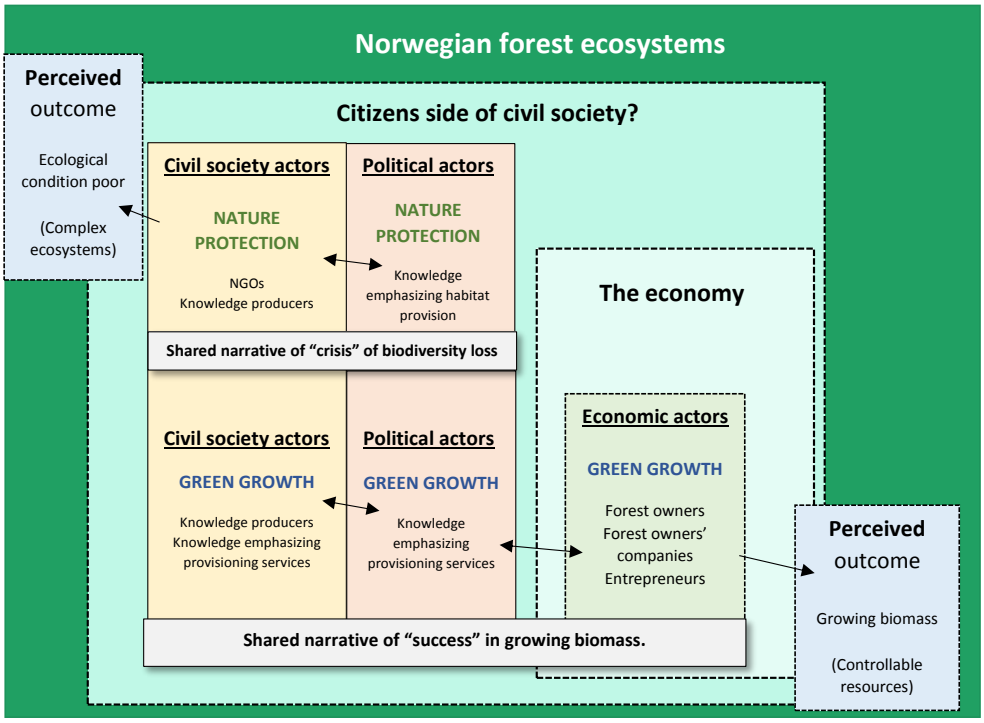

Figure 10: *An illustration of actors in Norwegian forest governance positioned in relation to 'green growth' or 'nature protection'. Developed from the EGS framework, that illustrates the interaction between ecological, political, and economic processes (Vatn, 2021).*

Overall, my results indicate that the dominating green growth narrative (and associated values) is given significant power in defining the conventions, norms, and regulations of Norwegian forest governance, while the nature protection pathway act as an 'opponent'. These pathways are also distinctly represented in valuation approaches affecting forest governance, and in VAIs such as cost-benefit analysis, impact assessments, forest plans,

and timber markets. As an example, the main VAIs primarily promote economic and instrumental values, while ecological values are also partially integrated (Helseth et al., under review).

Recently, Norwegian environmental NGO's and scholars are increasingly adopting market-oriented and utilitarian arguments for nature protection, such as systems for 'area neutrality' (Sabima, 2023), a 'nature fee' for infrastructure development (WWF, 2023), ecosystem accounting (SSB, 2021; NINA, 2023; UN SEEA, 2023). However, I did not find clear indications that nature protection supporters advocate changes in the institutional context and in the core values that guide decision-making. Furthermore, there are none of the two dominating pathways that emphasizes relational and cultural values, such as spirituality, sense of place, or local and traditional ecological knowledge and practices.

Overall, my results indicate that *the citizens side of civil society* – an important arena for creating the normative basis for society (Vatn, 2015; Vatn, 2021) – is poorly connected to decision-making in Norwegian forest governance. With the dominance of private forest ownership, the citizens side of civil society remain on the outside of forest-related decision making. Consequently, I find that Norway grants its inhabitants *the right to roam* in forests, while the right to govern forests is privileged to forest owners and to other economic, political, and formal civil society actors (such as NGOs). The lack of deliberative forest governance arenas coincides with a lack of openness toward other sustainability pathways than the dominating *green growth* pathway. Although rural policy documents give partly support to policies and values associated with the sustainability pathways of *degrowth* and *earth stewardship* (such as traditional reindeer herding and mountain farming) (Helseth et al., submitted), the literature reviews, interviews, and survey results does not indicate support to degrowth or earth stewardship in Norwegian forest governance.

5.3. Opening for broader values along alternative sustainability pathways

Reflecting on the need for *transformative governance*, the IPBES Values Assessment makes the case that "(...) creating an environment for questioning existing values, knowledge and structures; and giving opportunity to experimentation of new ways of governance based on knowledge co-creation and social learning processes are key enablers to manifest a transformation" (IPBES, 2022a:355-356). My thesis point to a need to reform institutions toward promoting diversity in forest ecosystem services and values. As argued in Article 3, this will require government action to ensure more inclusive forest governance approaches, that are less dominated by markets and experts, and better suited to enable deliberation and citizen participation (Helseth et al., under review). I argue that a key to more inclusive forest governance, is to shift participatory power beyond forest owners, market actors, and NGOs, to include those social actors whose values are relegated (particularly women and non-forest owners) (ibid.). Moreover, the results indicate that both forest governance and rural development should allow for broader deliberation of overall societal goals and future sustainability pathways, aligned with respecting a plurality of values. As pointed out by Robert Costanza more than 20 years ago:

> (...) one cannot state a value without stating the goal being served. Conventional economic value is based on the goal of individual utility maximization. But other goals, and thus other values, are possible. For example, if the goal is sustainability, one should assess value based on the contribution to achieving that goal, in addition to value based on the goals of individual utility maximization, social equity, or other goals that may be deemed important. This broadening is particularly important if the goals are potentially in conflict (2001:462)

In line with recent trends in the sustainability sciences, the results of this thesis indicate that governing forest for sustainable community development will require a broader pluralism of *core values*, including a shift away from competitiveness and utility, toward considerations of care, reciprocity, and justice, applying not only to the present population, but also to future generations and other species. In this regard, results indicate a need for Norwegian forest governance and rural policies to move beyond the

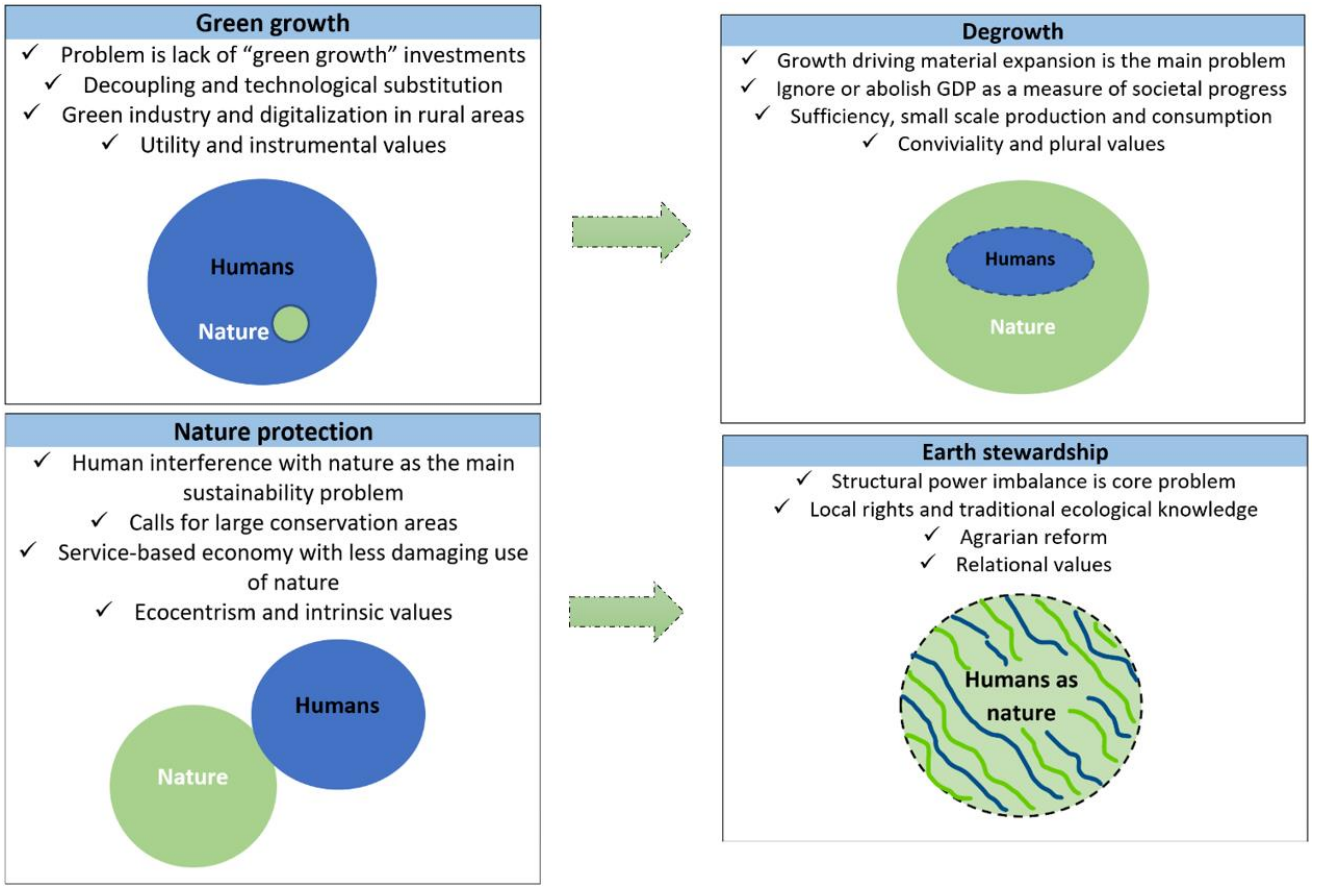

Figure 11: *Illustration of the four sustainability pathways described in Article 4 (Helseth et al., submitted; Martin et al., 2022). Norwegian forest governance is dominated by a green growth sustainability pathway, challenged by supporters of a nature protection pathway. Degrowth and earth stewardship are not on the agenda related to forest governance, but their deliberation may contribute to mobilize "sustainability-aligned values".*

dominating *green growth* pathway, to allow for deliberation of alternatives sustainability pathways, as outlined by the IPBES Values Assessment (Martin et al., 2022) (see Figure 11).

Otero et al. argue that "the unreflexive growth emphasis of the biodiversity and sustainability policies seems to stand in the way of safeguarding biodiversity" (2020:6), and makes the case for a *zero-growth scenario* to guide future environmental governance. Furthermore, degrowth and post-growth scenarios are getting increased attention in international research and policies, as pathways to prosperity without growth (see e.g., European Parliament, 2023). The core values emphasized within a degrowth pathway include egalitarianism, sufficiency, conviviality, and care, and degrowth supporters advocate value pluralism and *incommensurability* (D'Alisa et al., 2014; Hickel, 2020; Kallis et al., 2020; Martin et al., 2022). My results indicate that attention to a degrowth sustainability pathway is relevant for Norwegian forest governance and rural policies. Results from Article 4 also show that degrowth supporters promote small-scale, extensive practices related to production of food and materials (Helseth et al., submitted).

Supporters of an *earth stewardship* pathway are concerned with interconnectedness between people and nature. Associated core values are responsibility, care, solidarity across species, while earth stewardship also emphasizes specific relational values of nature, as well as biocultural diversity (Chapin III et al., 2009; Martin et al., 2022; Rozzi et al., 2015). Values and policies associated with an earth stewardship pathway may be particularly relevant for deliberating future venues for forest-related livelihoods, and the traditional knowledge and relational value connected to different forestry practices (Andersen, 2021; Kaldal, 2022). As an example, although research shows that more "close to nature" forestry practices, continuous forest cover, and increased rotation time is found to contribute to promoting a broader set of forest ecosystem services (Báliková & Šálka, 2022; Nordén et al., 2018; Peura et al., 2018; Pohjanmies et al., 2017), Norwegian forest governance have few institutions, instruments, and actors that promote such alternative forestry practices (Aspøy & Helseth, 2022).

In summary, I attempt to illustrate how deliberation of alternative sustainability pathways, and associated core values, may open for integration of plural forest values in

decision-making (Figure 12). This is also closely related to shifting forest governance institutions toward promoting citizenship and community-oriented decision-making.

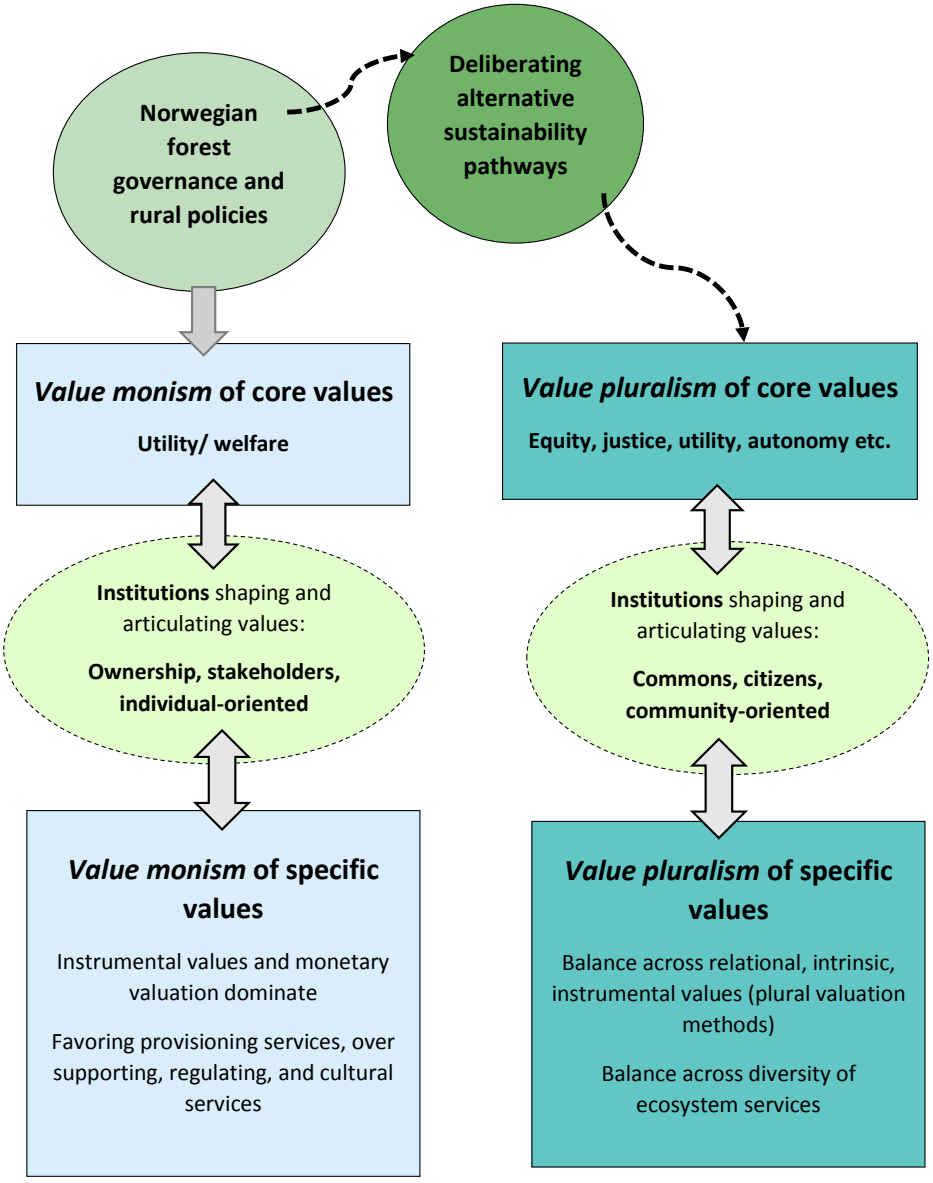

Figure 12: *Possible pathways from value monism to value pluralism*

6. Conclusion

Forest ecosystems are degrading worldwide, together with declines in forests biodiversity and ecosystem services. IPBES finds that the causes of the global nature crisis are linked to the way we value nature, as well as to the institutions and power dynamics defining which values are prioritized or excluded in political and economic decisions at all levels of society. Decision-making worldwide favor marked-based instrumental forest values at the expense of ecological and cultural values, that are often downplayed in decisions. This situation points to a need for deeper knowledge of the role of plural values and institutions in promoting sustainability transformations globally and locally.

Drawing on theory from ecological economics and institutional economics, this thesis used Norwegian forest governance as a case to examine how values and institutions shape the condition and trends of forest ecosystems, which forest benefits are prioritized and to whom. The thesis further examined how different approaches to valuing and governing forest ecosystems can promote transformative changes toward sustainable community development. In what follows, I summarize the main findings of the thesis.

The first research question was: "what have been trends, condition, and drivers of change of forest ecosystem services in Norway from 1950 to 2020?". The results showed that industrial forestry, large scale measures of reforestation and afforestation, and infrastructure development were main direct drivers of forest transformation, while deep changes in the Norwegian economy have shaped trends of forest ecosystem services. We found that Norwegian forests retain strong capacity to deliver provisioning services, but that important regulating and supporting services were in decline (Helseth et al., 2022)

To answer the second research question: "in which ways do economic instruments in Norwegian forest governance promote or constrain forests capacity to provide different ecosystem services?", I combined data on economic instruments with data on trends in forest ecosystem services. The assessment showed that the main economic instruments in Norwegian forest governance are markets for forest products and amenities, forestry certification schemes, and government expenditures such as subsidies for timber and payments for forest conservation. While markets for timber and hunting licenses amount to gross revenues of around 652.1 euros per year, subsidies, tax reliefs, and PES-schemes primarily target habitat provision (43.44 mill €/y), timber (38.17 mill €/y), and carbon

sequestration (2.53 mill €/y). Except for payments for voluntary forest conservation, most instruments target ecosystem services for which forests already have increasing capacity. The review also showed that services with declining or stable trends, such as sense of place and nutrient cycling, are sidelined, or even undermined by instruments targeting timber production and carbon sequestration (Helseth et al., manuscript).

The third research question was: "what is the role of social preferences, institutional arrangements, and power dynamics in mobilizing or restraining ecosystem services and values in Norwegian forest governance?". To answer this question, I used mixed methods, including in-depth interviews with forest experts and stakeholders and a survey (N = 1694) distributed among citizens in 10 rural municipalities in Norway, followed by a policy analysis to identify the most important value-articulating institutions in Norwegian forest governance. We found that local people rank ecosystem services embodying relational and intrinsic values higher than services that primarily embody instrumental values, and that women and non-forest owners show higher appreciation for relational values than men and forest owners. Survey results also show that local people do not feel empowered in forest governance, and that gender, forest ownership, and size of forest property are important markers of power in Norwegian of forest governance. Our analysis of dominating VAIs showed that existing institutions primarily mobilize instrumental values (Helseth et al., under review).

The last research question was: "how are values and livelihood options associated with competing sustainability pathways reflected in rural policies and in people's sustainability conceptions?". To reply to this question, I adapted the typology of sustainability pathways adopted by IPBES, and combined survey results (N = 3591), with an analysis of 15 influential policy documents guiding rural development. The results show that the narrative and practice of *green growth* strongly dominates rural policies agendas, followed by *nature protection*, and *earth stewardship*, while *degrowth* ideas are marginally represented. The results also show that one fourth of survey respondents (26.1%) primarily emphasize nature protection, sufficiency, or local production, while 17.5% perceive sustainable development to entail profit and economic growth, thereby showing that sustainability pathways other than green growth have footing among substantial shares of Norwegian rural population. Furthermore, the analysis showed differences in the sustainability perceptions held by green growth supporters and

degrowth supporters. While green growth supporters emphasize instrumental values and livelihood options based on tourism and industry, degrowth supporters emphasize intrinsic and relational values through small-scale farming and resource use (Helseth et al., submitted).

I use the knowledge and insight produced in these four articles, to answer the main problem statement of the thesis: *how can different approaches to valuing and governing forest ecosystems promote transformative changes toward sustainable community development?* The thesis shows that both forest governance and rural policies in Norway are dominated by a green growth sustainability pathway, promoting utility, efficiency, and instrumental values, whereas alternative sustainability pathways with stronger emphasis on intrinsic and relational values tend to be sidelined. In line with recent trends in the sustainability sciences, the results of this thesis indicate that governing forest for sustainable community development will require a broader pluralism of values, including a shift away from competitiveness and utility, toward considerations of care, reciprocity, and justice, applying not only to the present population, but also to future generations and other species. In this regard, the thesis makes a case for moving beyond the dominating green growth pathway, to allow for deliberation of alternative sustainability pathways such as degrowth, earth stewardship, and nature protection. I argue that broad deliberation of sustainability pathways and associated values is a key component of sustainability transformations and sustainable forest governance.

6.1. Theoretical and methodological contributions

Combining insights from economics, social science, and ecology, the thesis provides an interdisciplinary and broad case study of forest governance and forest values in Norway.

Novel scientific contributions include i) advancements in indicators to assess trends in capacity and flow of forest ecosystem services in Norway and ii) a framework for assessing relationships between economic instruments and trends in forest ecosystem services. Additionally, the thesis provides two in-depth empirical assessments that operationalize concepts introduced by the IPBES Values Assessment, including its typologies of values and sustainability pathways (IPBES, 2022a). First, I do an assessment of the relationship between *broad* values, *specific* values, and preferences for different

ecosystem services. Second, I advance a typology of sustainability pathways that enables the mapping of support for these pathways in policy documents.

6.2. Policy recommendations

The results of this thesis have potentially important policy implications at international, national, and local level.

First, while Norwegian forestry retains a strong focus on forest productivity for timber production as an asset for economic development, I argue that more attention should be given to increasing knowledge about forests ecological condition, resilience against climate change, and socio-cultural contributions to human well-being (Helseth et al., 2022). This is not only because of the intrinsic values of the ecosystems and species being lost or degraded, but also because a poor ecological condition and biodiversity loss will undermine the long-term capacity to provide ecosystem services and associated instrumental and relational values. However, the results also indicate that improved knowledge will not be sufficient for transformative sustainability changes, and that policymakers should be attentive to how values and institutions shape the condition and trends of forest ecosystems.

Second, results suggest that the Norwegian government should consider major reallocation of investments and government expenditures in order to diversify ecosystem services supply from Norwegian forests. This is also relevant for international policy developments, and it adds to global calls to reform economic instruments to safeguard biodiversity, and a broader array of forest ecosystem services, as suggested by science and policy initiatives like the Convention on Biological Diversity [CBD] (2010; 2022), IPBES (2019), and the EU Taxonomy Compass (2022).

Third, I bring attention to the need to reform institutions in order to safeguard diversity in forest ecosystem services and values. A promising venue for transformative change toward more just and sustainable futures would be more inclusive forest governance approaches, that are less dominated by markets and experts, and that enable planning processes characterized by deliberation and citizen participation. I argue that more inclusive forest governance will require government actions to engage the wider civil society in issues of forest governance. This includes extending participatory power beyond forest owners, market actors, and NGOs, to include those social actors whose

values are relegated. My results indicate that particular attention should be given to better include the values held by women and non-forest owners in decision-making. An important step in the Norwegian context, would be to redesign value-articulating institutions with emphasis on promoting relational and intrinsic values, and to develop specific guidelines for multicriteria valuation that allow decision makers and economic actors to recognize and capture a broader set of values into policy and planning. Specifically, the Norwegian Planning and Building Act should provide stronger and more clarified requirements for deliberative processes related to forest governance.

Fourth, if forests are to be protected together with their biodiversity, ecosystem services, and associated intrinsic, relational, and instrumental values, Norwegian rural policy should extend beyond green growth to facilitate deliberation of alternative sustainability pathways, such as degrowth, earth stewardship, and nature protection**.** My results indicate that the deliberation of such sustainability pathways is key to incorporate a wider diversity of values, and to balance diverse values for sustainability transformations.

6.3. Possible future research

The PhD results hints at several relevant topics for future research. First, it suggests that further research will be needed to in-depth examine the connection between the material/instrumental uses of forests and the types of relational values that have been predominant among Norwegians. I see a particular need for knowledge on the relevance of *alternative and traditional forestry practices*, such as selective logging and harvesting timber with horse, in developing and maintaining positive human–forest relationships.

Next, research in this thesis paves the way for further inquiries on the ways in which forests are valued and governed under different *ownership regimes*. Interesting questions for future research include i) how are forest values reflected and managed under different ownership regimes?, ii) which ownership regimes are best suited to promoting relational values and care for nature?

Third, and developing on the need for sustainability transformation, I believe it would be highly relevant to examine; i) what a *degrowth* or *earth stewardship* forest governance pathway may look like, ii) what decommodification of forest governance would/ could entail, and iii) what a 'fair share' of forest values and resources would entail – locally and globally (expanding on the relationship between social metabolism and valuation).

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Part 2: Articles and Appendices

Article 1: Forest ecosystem services in Norway: Trends, condition, and drivers of change (1950–2020). Published

Article 2: Unveiling imbalanced investments in forest ecosystem services. Manuscript

Article 3: Value asymmetries in Norwegian forest governance: The role of institutions and power dynamics. In review

Article 4: Beyond green growth: Mapping sustainability pathways for rural transformations in Norway. Submitted

APPENDICES

A.1. Semi-structured interview guide (translated to English)

A.2. Information letter to interview informants

A.3. Information to survey respondents

A.4. Survey: closed and open questions used for this research

A.5. Invitation to expert workshop on forest ecosystem services in Norway

Article 1

Helseth, E. V., Vedeld, P., Framstad, E., & Gómez-Baggethun, E. (2022). *Forest ecosystem services in Norway: Trends, condition, and drivers of change* (1950–2020). Ecosystem Services, 58, 101491. Ecosystem Services, doi: https://doi.org/10.1016/j.ecoser.2022.101491

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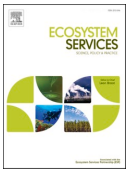

Full Length Article

Forest ecosystem services in Norway: Trends, condition, and drivers of change (1950–2020)

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ABSTRACT

Some regions like Europe have experienced a net gain in forest areas over the last decades, but intact areas of natural forests are declining worldwide, accompanied by changes in forest ecosystem functions and benefits to humans. We conduct a biophysical assessment of trends, condition, and drivers of change of forest ecosystem services in Norway from 1950 to 2020. Four main results are highlighted. First, industrial forestry, large scale measures of re- and afforestation, and infrastructure development (e.g., roads and recreational homes) have been the main direct drivers of forest transformation. Second, deep transformations in the Norwegian economy shaped trends of forest ecosystem services over the study period. Third, with the shifts towards the tertiary (service) sector and the mechanization of forestry, the economic and material relations between forests and local communities are waning. Overall, people's primary relationships to forests have shifted from livelihood to recreation. Fourth, forest management in Norway has largely favored provisioning services at the expense of supporting services and some cultural and regulating services. Consequently, while Norwegian forests retain strong capacity to deliver provisioning services, the overall ecological condition is relatively poor. Our assessment provides an approach to identify and explain trends of ecosystem services at a national scale, over a long period of time. We argue that growth in forest area and biomass are insufficient indicators for sustainable forest management, and that future forest polices would benefit from improved knowledge on forests ecological condition, resilience against climate change, and socio-cultural contributions to human well-being.

1. Introduction

The Millennium Ecosystem Assessment (2005) found that two thirds of the world's ecosystem services were declining, and the recent global assessment report from the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services documents an acceleration of global drivers of ecosystem degradation (IPBES, 2019).

Forests cover nearly-one third (30 %) of the global land area (World Bank, 2020). A majority of terrestrial species of animals and plants reside in forests (FAO, 2020) and this biodiversity sustains critically important ecosystem services, including raw materials, food production, outdoor recreation, sense of place, and carbon sequestration (Brockerhoff et al., 2017; Gauthier et al., 2015; Jenkins and Schaap, 2018; Shvidenko and Gonzalez, 2005). Deforestation and forest degradation constitute severe threats to forest ecosystems (FAO, 2020), and global forest areas have been reduced by more than two thirds (68 %) from pre-industrial levels (IPBES, 2019). The rate of global forest loss has declined since the 1980s, but forests are still rapidly disappearing in many tropical regions (Díaz et al., 2019). The area of "intact" forests is declining in both developed and developing countries (IPBES, 2019), resulting in losses of biodiversity and environmental values (Watson et al., 2018).

Some regions like Europe have experienced a net gain in forest areas over the last decades, although at a lower rate in 2010–2020 compared to 2000–2010 (FAO, 2020; Keenan et al., 2015). The drivers leading to increases in some temperate and boreal forests are diverse, and include restoration of natural forest, planting of monocultures with fast growing tree species (IPBES 2019), and abandoning of agricultural land (Navarro and Pereira, 2012). However, increases in forest biomass and extent are often accompanied by fragmentation and changes of forest functions

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(Díaz et al., 2019), e.g. with decline in habitats for species. Such forest changes entail social, environmental and economic costs that often remain unrecognized or undervalued in forest management (TEEB, 2010).

Forests have been part of the main global ecosystem service assessments (MEA, 2005; IPBES, 2019), regional assessments such as the Mapping and Assessment of Ecosystems and their Services (MAES) in Europe (e.g., Maes et al., 2020), and some national ecosystem assessments [NEA] (e.g., the Spanish NEA, 2013; and the UK NEA, 2011). The European MAES provides important advancements within ecosystem service framework and methodologies, as well as key policy insights for the EU Forest Strategy 2030 (European Comission, 2021).

To date, however, most assessments of forest ecosystem services are local case studies (e.g., García-Nieto et al., 2013; Joshi and Joshi, 2019), often focused on specific services (Mengist and Soromessa, 2019). Although many countries face policy dilemmas associated with sustainable forest management (Lindahl et al., 2017; Edwards et al., 2022; Pohjanmies et al., 2017), we find few broad assessment of forest ecosystem services at national scales. Further, national forest policies may be informed by knowledge on how relevant drivers of change affect trends in ecosystem service over time (see e.g., Berglihn and Gómez-Baggethun, 2021).

Here, we conduct a biophysical assessment of forest ecosystem services in Norway for the period 1950–2020. Although extensive research has been conducted on aspects such as total biomass, carbon sequestration, and the ecological condition of Norwegian forests, major knowledge gaps remain, including overall trends in forest ecosystem services (Lindhjem and Magnussen, 2012) and a comprehensive overview of associated drivers of change (NOU, 2013). With the aim of covering these knowledge gaps, the specific objectives of this paper are: i) to identify the most important ecosystem services provided by forests in Norway, ii) to assess the trends and condition of forest ecosystem services, and iii) to identify the most important direct and indirect drivers of change affecting forest ecosystem services.

2. Study area

Norway has a mainland area of 323 808 km^2. With 5.3 million inhabitants and an average of 16 persons per km^2, Norway is one of the most sparsely populated countries in Europe (SSB, 2019). Forests cover more than one third (37.4 %) of the country (SSB, 2019), amounting to 2.28 ha of forest per person. The Norwegian forest area is dominated by a mix of Norway spruce (27.3 %), Scots pine (29.6 %), birches and other boreal deciduous trees (40 %) (NIBIO, 2020b).[1] Most of the forest biomass is concentrated in the south-eastern part of the country (Fig. 1).

Just above 70 % (87 000 km^2) of the forest area is defined as productive,[2] while the remaining 30 % is not deemed economically viable (NIBIO, 2020b; SSB, 2020c). About ¾ (77 %) of the productive forest land is privately owned (Statskog, 2015). Most rights for extracting raw materials (e.g. logging, hunting, and fishing) belong to the landowner, while permission for picking wild berries, mushrooms, and plants in forests is granted through the principle of common access rights to all uncultivated land known as the "the right to roam" (Outdoor Recreation Act, 1957, section 2) (Reusch, 2021).

Norwegians have historically altered their forests to sustain livelihoods and rural settlements, e.g. through the provision of food, firewood, and timber (Hoen et al., 2019). Over the last 5000 years, most coastal areas with deciduous woodland in Western Norway were gradually deforested to cultivate land and provide winter pastures for livestock (Hjelle et al., 2018). Human pressure on Norwegian forests increased during the Middle Ages, partly due to growing coal pit burning for iron production. Mining, glass production, and harvesting of timber (particularly oak) for boatbuilding and exports further increased pressures on forests during the 16th and 17th centuries (Müller, 2018; Storaunet and Framstad, 2020). Amount and quality of accessible timber declined gradually, but by the end of the 19th century new wood processing industries could make use of smaller sizes and lower quality of timber (Storaunet and Framstad, 2020).

By 1916, scientists warned that the timber resources in Norwegian forests had been strongly reduced and degraded (NIBIO, 2019; SSB, 2015), spurring the Norwegian Government to develop national plans for large scale reforestation and afforestation processes.[3] From around 1950, the dominant forest management model in Norway shifted from dimensional logging and intensive selective cutting towards so-called even-aged forestry, where a whole forest stand is cut and re-planted as a unit. Following these policy shifts, the total forest biomass has tripled over the past century, while the forest area has increased by around 10 % (NIBIO, 2019; SSB, 1927; Storaunet and Framstad, 2020).

Forests are an important renewable resource contributing to value creation locally, regionally, and nationally in Norway (MAF, 2016, 2019), but the relative economic importance of forestry has declined over recent decades. Forestry employment dropped from around 28 500 in 1950 to 6 600 in 2018 (Tomter and Dalen, 2018), and forestry's contribution to Norwegian GDP has gone down from 2.5 % in 1950, to 0.2 % by 2020 (SSB, 2019). Over the last decade, however, a rise in timber prices has been accompanied by increased timber harvest. In 2021, the timber harvest peaked at 11.5 million m^3 timber sold for industrial purposes, with a total timber value of about 5.4 billion NOK (around 540 million EUR) (NAA, 2021a). Forests are also increasingly promoted as important renewable resources contributing to the "green shift" and towards a future *bioeconomy* (MAF, 2016, 2019).

Besides economic contributions measurable in money, Norwegian forests also provide a wide range of cultural, regulating, and supporting ecosystem services. Forests off-set close to half the Norwegian carbon emissions (NEA et al., 2017), and are home to about half of the endangered species in Norway (Artsdatabanken, 2021). Forest areas are also widely used for outdoor recreation (NEA, 2020a). Multiple functions of forests gained prominence on the national policy agenda from around 1980–90, e.g. with the emergence of the concept of "multiple use forestry" (Halberg, 1999).

3. Methods

Our assessment was developed in four main steps: i) classification and categorization of ecosystem services, ii) development of assessment indicators, iii) definition of indicators for drivers of change, and iv) validation of results.

3.1. Classification and categorization of ecosystem services

Important ecosystem services from Norwegian forests were identified from a comprehensive literature review. Data sources included scientific papers and reports, policy documents, books, and data from official national statistics. Starting from a broad, historical review of forests and forest governance in Norway, we drew on relevant classifications and criteria (see below) to identify the most important services for our study period. As the term ecosystem services is of relatively recent use in Norwegian policy and scholarship, it was rarely mentioned explicitly in the relevant literature, so descriptions of nature's benefits under different rubrics (e.g., natural resources, cultural values,

[1] The remaining forest area consists of temperate deciduous trees and forest area temporarily without tree cover.

[2] Forest with a production of at least 1 m^3 timber per hectare per year (SSB, 2020c).

[3] In Norway, the term afforestation («skogreising») is used about measures of planting species of trees that can give higher production than native species (mainly in coastal areas), or planting of forest in areas with no previous forest cover (Tomter and Dalen, 2018).

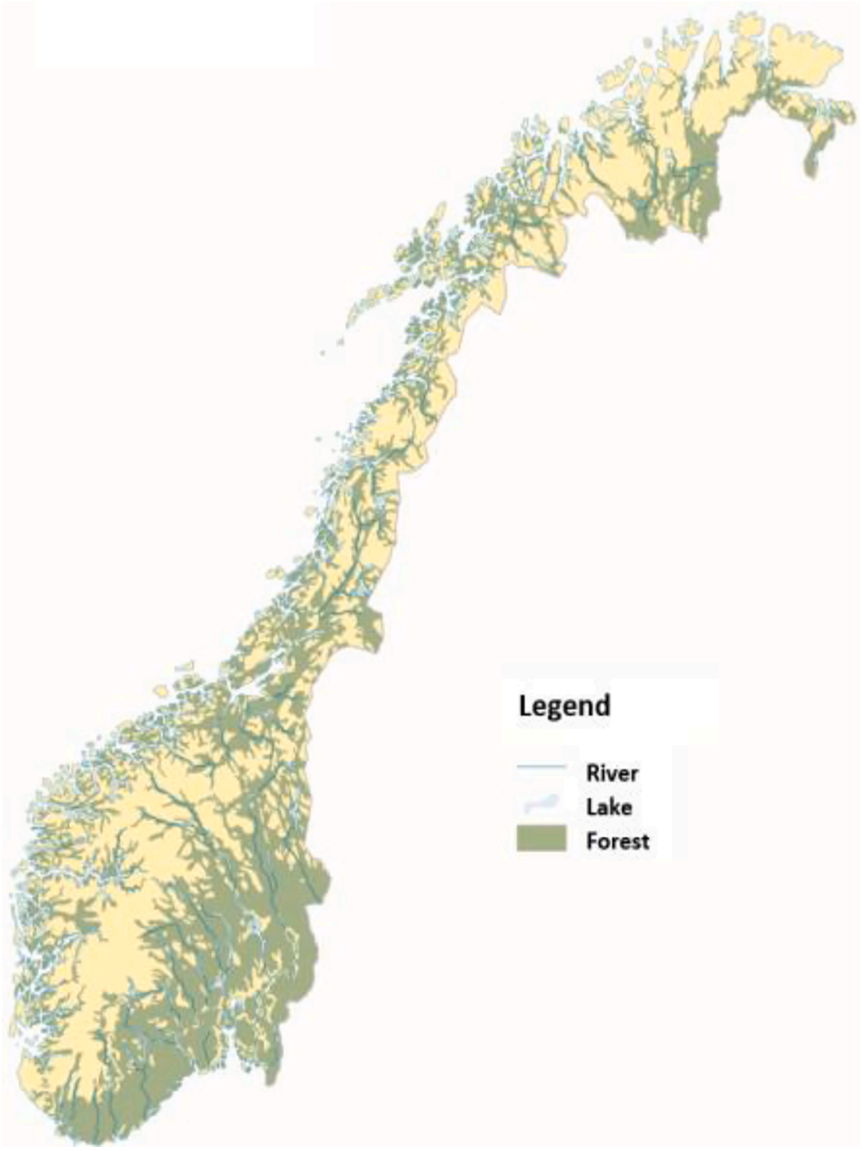

Fig. 1. Map of Norway showing areas of forest and water, 2020 (Geonorge, 2020).

ecosystem functions) were translated and coded into the language and framework of ecosystem services.

Following established international classifications from the Millennium Ecosystem Assessment (MEA, 2005) and The Economics of Ecosystems and Biodiversity (TEEB, 2010), we classified ecosystem services into the four *main categories* of provisioning, cultural, regulating and supporting services. In lines with the UK NEA, cultural ecosystem services are defined here as "ecosystems' contributions to the non-material benefits (e.g., capabilities and experiences) that arise from human–ecosystem relationships" (Chan et al., 2011:206). Under each main category we identified the most important *types* of ecosystems services, adapting categories from international classifications to the Norwegian context (we e.g., identified *raw materials* and *food production* as the most relevant types of provisioning services).

Criteria for choices of most important services were i) relevance for people and communities, ii) importance to the national economy and/or policy, and iii) whether the contribution of forest ecosystems in providing the service could be clearly identified and described. Further, we attempted to avoid services with too much overlap. To prioritize the most important services, we drew on recent assessment of Norwegian forest ecosystem services (Lindhjem and Magnussen, 2012; NOU, 2013:10, 2013), and on discussions in an interdisciplinary expert workshop (see 3.4. for details). Some ecosystem services that were considered in the initial mapping, were not included in the final assessment based on the above criteria and inputs from the expert workshop.

When appropriate, we broke down ecosystem service types (e.g., raw materials) into *subtypes* (e.g., timber and bioenergy). Some activities, like hunting and harvesting of wild foods, have a hybrid character between provisioning and cultural services. In such cases we defined

indicators that best reflected the relevant purpose of the activity related to the service (cf. Gómez-Baggethun et al., 2019). For example, to assess *food production*, we used number of animals felled as a proxy indicator, while to assess *outdoor recreation*, we used the number of active hunters that have paid the hunting license fee, as well as number of people registered in the national "Register of Hunters".

3.2. Definition of ecosystem service indicators

We assessed trends and condition for each ecosystem service. In line with recent developments in the ecosystem services literature, our definition of trends distinguished ecosystem service *capacity*, *flow* and *demand* (Baró et al., 2016). Capacity is defined here as "an ecosystem's potential to deliver services based on biophysical properties, social conditions, and ecological functions" (Villamagna et al., 2013:116) whereas flow is defined as "the service actually received by people" (Villamagna et al., 2013:118). As an example, standing timber biomass is an indicator of capacity whereas volume of harvested timber is an indicator of flow (Burkhard et al., 2014). Demand is defined here as "the amount of a service required or desired by society" (Villamagna et al., 2013:116). Since many ecosystem services are public goods and operate outside markets, trends in societal demand were assessed with reference to national policy targets (Baró et al., 2016).[4]

Table A.1. in the supplementary material (Appendix 1) provides an overview of the indicators chosen for our assessment. Capacity for *provisioning services* was measured directly through biophysical properties (e.g. forest area or tree biomass), while capacity for *cultural services* was proxied by combining biophysical properties and anthropogenic conditions (e.g., quality and accessibility) (Villamagna et al., 2013). We measured capacity for *regulating services* through aggregated data on biophysical properties defining regulating functions of forests that provide benefits to people and communities. In cases where quantitative data was not available, we relied on qualitative descriptions of changes in relevant biophysical properties and ecological functions over the study period. For measuring capacity of habitat provision (*supporting services)*, we e.g., used data from the Nature Index of Norway and assessments of the ecological condition of forest ecosystems in Norway (Aslaksen et al., 2015; Certain et al., 2011; Framstad et al., 2022; Storaunet and Framstad, 2020).

Flow was measured either directly through indicators assessing the amount of a service delivered, or by proxy indicators, e.g. number or share of beneficiaries (Villamagna et al., 2013). For ecosystem services that are difficult to quantify (e.g. sense of place), data from qualitative descriptions was used as a supplement to numerical data (Chan et al., 2012a).

The UK NEA (2014) bring attention to some particular challenges of measuring cultural service (see also Chan et al., 2012b; Plieninger et al., 2013), and emphasize that cultural services arise from human-nature relationships (Church et al., 2014). Our distinction between trends in *capacity* and *flow* allows for addressing different aspect of each service, and thus broadening this relational understanding. For example, for outdoor recreation and tourism, indicators of flow give information about how much people use forest for recreation, while indicators of capacity give a broader picture of forests ability to provide the service (e.g., *accessibility*). However, the ways in which forests contribute to people's recreational experiences – and to people's *sense of place* – will vary across cultures and individuals. Accurate measurements and descriptions of cultural ecosystem services thus depend on local studies with in-depth knowledge of the relationships between communities and ecosystems (see e.g., Kaltenborn et al., 2020).

[4] National policy targets can also be important drivers of change. In our assessment, we distinguish between *trends in demand* (measured by policy targets), and indirect drivers of change (assessed and described in section 4.2.1.), although these are closely connected.

Trends in ecosystem service *capacity* and *flow* over the study period were classified as increasing, stable, or declining. The time-period 1950–2020 was chosen because i) it is broadly consistent with the time frames of the MEA (2005) and IPBES (2019) which allows for comparison with global ecosystem assessments, ii) it covers the period of the so-called *great acceleration* (Steffen et al., 2015), which also involved fast transformations in Norwegian forests, and iii) it provides a relevant time frame to inform policy and planning. When data for the 1950–2020 period was not found, available data closest to this period was used and specified. Uncertainty in data sources was acknowledged and labelled as i) low, ii) medium, or iii) high depending on data quality and level of consistency across consulted sources (see also Gómez-Baggethun et al., 2019).

Data from the Norwegian Forest Inventory (NFI) (SSB, 2022b) and the Nature Index of Norway (Certain et al., 2011; Storaunet and Framstad, 2020) were used to collect information on the overall status of Norwegian forest ecosystems. Building on these data, we classified the *condition* of forests to deliver each type of ecosystem service as i) good, ii) acceptable, or iii) poor. Condition was classified as good when forests have good ecological status and/or high capacity to supply the relevant service, relative to the current levels of use (flow) and demand for the service.

3.3. Characterization of drivers of change

We adapted the classification of drivers of change from the MEA (2005) framework. This framework differentiates direct and indirect drivers of ecosystem change, defined as "natural or human-induced factors that directly or indirectly cause a change in an ecosystem" (2005:64). Direct drivers are driving forces that "unequivocally influences ecosystem processes", while indirect drivers operate more diffusely "by altering one or more direct drivers" (2005:64).

In addition to data from previous global and sub-global assessments (IPBES, 2019; MEA, 2005), we used knowledge about drivers of change from earlier studies of forest ecosystems in Norway (Framstad et al., 2022; Lindhjem and Magnussen, 2012; NOU 2013:10, 2013). Table A.2. in the supplementary material shows the selected indicators for assessing direct and indirect drivers of change.

3.4. Expert workshop

In order to validate/revise our results, a workshop with 19 forest experts from different institutions and disciplinary backgrounds was convened on 27th of May 2021. Participants included ecologists, economists, and social scientists. The workshop consisted of three main parts. First, details on methodology, selected indicators, and preliminary results were presented to the experts. Next, experts worked in groups providing feedback on trends of capacity and flow for specific ecosystem service categories. Finally, the experts conducted qualitative assessments of the impact of specific drivers of change on different categories of forest ecosystem services. Inputs from the workshop were used to verify or adjust preliminary results on trends, condition, and drivers of change.

4. Results

4.1. Ecosystem service trends and condition

We identified eight types of ecosystem services, including two provisioning services, two cultural services, three regulating services and one supporting service. Some services were classified in several subtypes, which trends in capacity and flow were also assessed. Table 1 provides an overview of trends in ecosystem service capacity, flow, and demand from 1950 to 2020 for all identified ecosystem service types and subtypes (based on indicators identified in Table A.1. in Appendix 1). Table 1 also shows the condition of each ecosystem service type.

Table 1
Classification of forest ecosystem services in Norway, 1950–2020: trends of capacity, flow, and demand, and the condition of forests to supply the relevant service. (See below-mentioned references for further information.)

Ecosystem service type	Ecosystem service subtype	Capa-city	Flow	Demand	Condi-tion	Overall trend	Main sources,see also Table A.3
Provisioning services – Physical goods obtained from forest							
Raw materials		⇧	⇧	⇧		Capacity for extracting energy and materials from forest for direct use or processing has increased considerably with growth in timber biomass, while flow has had a small increase.	(Lindhjem & Magnussen, 2012; MAF, 2016; SSB, 1954; SSB, 2020e; SSB, 2020f; Tomter & Dalen, 2018)
	Timber	⇧	⇧				
	Bioenergy	⇧	⇧				
Food production		⇧	⇔	⇔		Capacity for game meat has increased with growing numbers of wild ungulates, while capacity for livestock grazing and wild foods has remained relatively stable. Increase in use (flow) of game meat, while decline in livestock grazing and harvesting of wild foods.	(Asheim & Hegrenes, 2006; Austrheim et al., 2008; Harstad, 2018; Harstad, 2021; SSB, 2019; Strand et al., 2021),
	Livestock grazing	⇔	⇩				
	Game meat	⇧	⇧				
	Wild foods	⇔	⇩				
Cultural services - Ecosystems' contributions to the non-material benefits that arise from human–ecosystem relationships							
Outdoor recreation and tourism		⇔	⇧	⇧		Increases in capacity with growth in enabling infrastructure, although infrastructure developments and industrial forestry has also caused decline in some attractive qualities for recreation. Increases in use (flow) for hiking, hunting and tourism, while there has been decline in skiing and harvesting of wild foods.	(Andersen & Dervo, 2019; Breidenbach et al., 2017; Lindhjem & Magnussen, 2012; NEA, 2014; NEA, 2020a; SSB, 2017; Tomter & Dalen, 2018)
	Hiking	⇔	⇧				
	Skiing	⇔	⇩				
	Hunting	⇧	⇧				
	Wild foods	⇔	⇩				
	Tourism	⇔	⇧				
Sense of place		⇔	⇔	⇔		Qualitative transformations, with no clear upward or downward trend, as the primary relation to forests has shifted from livelihood to recreation	(Lindhjem & Magnussen, 2012; SSB, 2015; Tomter & Dalen, 2018)
Regulating services - Benefits humans derive from ecological regulation processes							
Carbon sequestra-tion and storage		⇧	⇧	⇧		Carbon sequestration has increased, due to growing biomass. However, there are uncertainties regarding sequestration and storage in old-growth forests, and in forest soils.	(Bartlett et al., 2020; NEA, 2020b; Stokland, 2021; Søgaard et al., 2019; Tomter & Dalen, 2018)
Nutrient cycling		?	⇩	⇧		Industrial forestry and increased sulfur and nitrogen deposition through long-range air pollution has negatively affected capacity - although the extent of a declining trend is uncertain.	(Austnes et al., 2018; Bernes, 1993; Helmisaari et al., 2011; Lindahl & Clemmensen, 2016; Sterkenburg et al., 2019; Tomao et al., 2020)
Moderation of extreme events		⇩	⇩	⇧		Capacity declined in some areas, mainly due industrial forestry, with increased reliance on management of monocultures of even-aged forests and harvesting through clear-felling.	(Hofstad, 2020; Nordrum et al., 2020; Norsk Klimaservicesenter, 2017; VKM, 2021; NOU 2013:10; NGI, 2013)
Supporting services - Services necessary for the production of all other ecosystem services							
Habitat provision		⇩	⇩	⇧		Decline in capacity and flow due to declines in wilderness-like areas and in share of not previously clear-felled forests. Norway also has little old-growth forests, and the ecological condition of forest is relatively poor.	(Artsdatabanken, 2021; Certain et al., 2011; Framstad et al., 2022; NEA, 2018; Storaunet & Framstad, 2020; Storaunet & Rolstad, 2020)

Source: Own elaboration with icons by Jan Sasse for TEEB (except for icons 'outdoor recreation' and 'sense of place'). ↑=increased; ↔=remained stable; ↓=decreased and? =Not assessed due to lack of data and/or large level of uncertainty. Condition of main type of ecosystem service is indicated by colors; green (good), yellow (acceptable), red (poor). See detailed data, descriptions, and sources in Table A.3 in the supplementary material.

Detailed data and descriptions of trends within capacity and flow of each ecosystem service (type and subtypes), can be found in Table A.3 in the supplementary material.

4.1.1. *Provisioning services*

Forests' *capacity* for providing *raw materials* has increased notably, as standing timber biomass has grown from 322.3 million m^3 in 1933 (SSB, 1954) to 974 mill. m^3 in 2018 (SSB, 2020c). Over the same time period, the productive forest area has increased by around 10 % (Storaunet and Framstad, 2020). The amount of timber harvested (flow) for sale to industrial purposes grew from 7 123 000 m^3/year in 1950 (SSB, 1950) to 10 242 000 m^3/year in 2020 (SSB, 2021b). Furthermore, national statistics report an increase in production of bioenergy[5] over the years of the study period for which data were available, e.g. from 9.9 TWh of bioenergy produced overall in Norway in 1990 to 13 TWh in 2020 (SSB, 2021a).

Capacity to supply food through game meat increased along with a growth in populations of wild ungulates in the forests (Austrheim et al., 2008; Larsson and Sandved, 2018). The capacity to sustain livestock,

[5] Bioenergy ("biobrensler") is also produced from other inputs than forest biomass, but national energy statistics do not distinguish between bioenergy from forest biomass and other types of biomasses.

measured by "fodder units"[6] in outfield pastures and the ecological condition of grazing forest, has remained relatively stable (Framstad and Bendiksen, 2018; Strand et al., 2021). When it comes to flow, the use of outfield pastures for *food production* has more than halved since 1950, but there has been a strong growth in game-meat from forests, e.g., from 660 red deer felled in 1950 to 46 356 in 2020 (Asheim and Hegrenes, 2006; Austrheim et al., 2008; SSB, 2020b). Hence, the overall use (flow) of food production has remained relatively stable.

A growing human population, higher consumption per capita, and recent policy developments to promote a bioeconomy through increased use of forest resources (MAF, 2019, 2016; SSB, 2019), signals a growing societal demand for raw materials and food production. Overall, the condition of these services is classified as good, as forests maintain high capacity to supply them (e.g., Strand et al., 2021; Tomter and Dalen, 2018).

4.1.2. Cultural services

Some of forest's *capacity* to contribute to *outdoor recreation and tourism* has increased through improved accessibility, facilitated by e.g., increased public transport and enabling infrastructure. However, capacity has also been negatively affected by deforestation close to settlements and negative effects of climate change on activities such as skiing (Breidenbach et al., 2017; Lindhjem and Magnussen, 2012; Norwegian Climate Foundation, 2016). Further, as industrial forestry has changed the structure of wide areas of the forest landscape to younger and more homogeneous forests (Kuuluvainen, 2009), the experiential values of the forests may be substantially reduced for some people (Gundersen and Frivold, 2008). The overall use of forests for recreation (flow) has increased in both absolute and relative (per capita) terms (Kirkemo et al., 2020; SSB, 2017), while the number of recreational homes and revenues from forest-based tourism has also increased (e.g. Andersen and Dervo, 2019; Norges Skogeierforbund, 2012; SSB, 2007b, SSB, 2020d). Trends within flow of subtypes vary, and detailed descriptions of these trends can be found in Table A.3. in the supplementary material.

Sense of place has experienced qualitative transformations, with no clear upward or downward trend, as the primary relation to forests has shifted from livelihood to recreation (SSB, 2015, SSB, 2017, SSB, 2020d). In the mid-20th Century, forest management still relied largely on human labor and most farmers managed their own forests, acquiring local ecological knowledge and experienced-based skills that were intertwined with local values and norms. By contrast, most forest management today is outsourced to specialized firms (SSB, 2015), and the majority of forestry work is mechanized (SSB, 2007b). On the other hand, the growing use of forests for outdoor recreation (MCE, 2018; NEA, 2014; SSB, 2017) testify to how recreational aspects of forests increasingly contributes to many Norwegians' *sense of place*.

Demand for outdoor recreation and tourism is high and growing, and the condition is classified as good. Although trends have worked in opposite directions, forests overall capacity to supply recreation is high, due to large extent of forested areas, recreational infrastructure (e.g., lodges and a wide network of marked paths), and accessibility (e.g., through public transport). Sense of place is classified as acceptable, and there are uncertainties regarding how qualitative shifts in human-forest relationships affects capacity for this service.

4.1.3. Regulating services

Capacity of forests to *sequester and store carbon* has increased over the study period along with the above reported increases in biomass. Although increases in timber harvest have detracted capacity for carbon sequestration, timber biomass has grown at a faster rate than the timber harvest, resulting in an overall increase of carbon sequestration capacity. The carbon stocks in living biomass of forest trees were 345 million tons in 1990, and 470 million tons in 2015 (Tomter and Dalen, 2018). By 2018, the net-uptake of CO_2-equivalents in Norwegian forest were 28 million tons, with forest biomass offsetting approximately 54 % of domestic carbon emissions (NEA et al., 2017; Tomter and Dalen, 2018). However, there are also significant uncertainties regarding sequestration and storage in old-growth forests, and in forest soils (Bartlett et al., 2020; Stokland, 2021).

Although clear-felling has increased dramatically since 1950, leaving the branches of trees in the forest after harvesting has remained a common practice, thereby securing that significant amounts of nutrients remain in the forests (expert workshop, 2021). However, clear-felling can interrupt the local functioning of mycorrhizal fungi in *nutrient cycling* for up to several decades (Lindahl and Clemmensen, 2016; Sterkenburg et al., 2019; Tomao et al., 2020). Increased nitrogen fertilization (NIBIO, 2020a) and draining of wet forests since the 1950s (Bernes, 1993) are also likely to have changed nutrient cycles, while long-range air pollution (e.g. from industry in the UK) has increased sulphur and nitrogen deposition in forests, resulting in leaching of nutrients from forest soils in southern parts of Norway over several decades (Austnes et al., 2018; Falkengren-Grerup et al., 1987; Steinnes et al., 1993). Combined, these factors have negatively affected nutrient cycling in forests, although the extent of a declining trend is uncertain.

Lack of aggregated data at national level (Lindhjem and Magnussen, 2012; Nordrum et al., 2020) and drivers acting in opposite directions make it hard to determine overall trends in forests' capacity for *moderation of extreme events*. On the one hand, increases in forest area may suggest a positive trend. On the other hand, the increased share of even-aged forest monocultures and harvesting through clear-felling, have likely reduce resilience against storms, landslides, and floods in the affected areas (Nordrum et al., 2020; VKM, 2021; NGI, 2013). Hence, industrial forestry practices combined with deforestation close to settlements, indicate that the capacity to prevent flooding and landslides has declined in areas located close to infrastructure (where this service is needed). Further, the Norwegian Scientific Committee for Food and Environment (VKM) find that diversification of Norwegian forests would improve resilience towards future climate change (2021).

Increased prominence of climate mitigation policies has driven a strong growth in demand for *carbon sequestration and storage* (NEA, 2020b), and due to high and growing capacity, the condition of this service is classified as good. The condition of nutrient cycling is classified as acceptable, e.g., due to uncertainty of the extent of the declining trend in capacity. An increase in the frequency of extreme weather events (Norsk Klimaservicesenter, 2017) has contributed to growing societal demand for *moderation of extreme events,* while the condition is classified as acceptable.

4.1.4. Supporting services

The Norwegian Nature Index (Certain et al., 2011; Storaunet and Framstad, 2020) measures biodiversity status, thereby offering a good proxy to assess changes in the *capacity* for habitat provisioning. The index classified the biodiversity status of Norwegian forests as relatively poor by 2020, with a value of 0.41 against a reference value of 1.[7] The index suggests a relatively stable trend over the 30 years assessed (1990–2020) but increases in infrastructure and industrial forestry (with clear-felling) negatively affected habitat provision since 1950. As an illustration, around 1940, one third of Norwegian land area was

[6] One fodder unit is defined as 6900 kJ net energy (kJ NE), equivalent to the value of 1 kg standard barley for milk production (Harstad, 2018).

[7] The reference value is based on natural forest with a small degree of human interventions, in which natural disturbance processes with subsequent succession stages are present on all forest area (Storaunet and Framstad, 2020).

classified as wilderness-like,[8] whereas by 2018 this share had declined to 11.5 % (NEA, 2018). Further, although Norway had only marginal areas of old-growth forest left by 1950 (due to intensive forestry, especially since the mid-1800s), few forest areas were at the time affected by clear-felling. Despite the increases in total forest area over the study period, only a very small share of the productive forest area is today older than 160 years (2.5 % in 2016) (Tomter and Dalen, 2018), while the share of not previously clear-felled forest has dropped to around 30 % of the productive forest area (Storaunet and Rolstad, 2020). This increase in the prominence of semi-natural forests and forest plantations at the expense of remaining old, not previously clear-felled forests poses significant challenges to the 84 % of threatened forest species which depend on old forests (Artsdatabanken, 2021; Framstad et al., 2022).

There is growing demand for habitat provision resulting from changes in social values and the endorsement of international biodiversity treaties and forest protection policies. Lack of historical data for most species makes it hard to indicate the extent of a declining trend in habitat provision, but the current ecological condition is classified as poor (Framstad et al., 2022).

4.2. Drivers of change

Changes in Norwegian forests and forest ecosystems services over the study period are caused by a range of indirect and direct drivers specified below.

4.2.1. Indirect drivers

We identified a complex mix of economic and sociopolitical factors as the most important indirect drivers affecting forest ecosystem services. Major indirect drivers of change such as population and economic growth, urbanization, and consumption are shown in Fig. 2, together with indication of variations in their scale over the study period.

First, forest ecosystem services have been largely shaped by deep transformations in the Norwegian *economy* connected with economic growth, trade liberalization, outsourcing of industry, and the emergence of the oil and gas sector. Norway's GDP increased from approximately 259 billion NOK in 1950, to 2059 billion NOK in 2011 (in 2005-prices), during which the economy shifted its primary reliance from agriculture and industry towards the tertiary (service) sector (SSB, 2019, SSB, 2020a). Sustained economic growth was an important driver of infrastructure developments in forest and mountainous areas, such as roads and recreational homes (Kjensli, 2018), while the shift towards the tertiary sector caused abandonment of marginal agriculture, leading to forest expansion in many coastal and mountain areas (Bryn et al., 2013). Technological development, relative decline in timber prices (Tomter and Dalen, 2018), and increased wages, were all important drivers for the mechanization of forestry (Halberg 1999). Further, the paper and pulp industry developed in the 1950s and 1960s has declined strongly over the last decades (SSB, 2015, Tomter and Dalen 2018).

Second, forest ecosystem services have been strongly affected by *sociopolitical* drivers. Leading up to 1950, forest researchers debated if the best option for future Norwegian forestry would be selective felling of uneven-aged forests or clear-felling of even-aged, monoculture forests (Nygaard and Øyen, 2020). The latter option was strongly inspired by scientific forestry and ideas of modernity.[9] In 1938, the Norwegian government adopted a forestry plan that included the reforestation of 1500 km^2 of sparse coniferous forest with "deficient rejuvenation", with the aim of securing future access to raw materials (Bækkelund, 2020). The plan was designed around even-aged forestry, which resulted in the adoption of this practice as the official forestry model, and marked a start of modern, industrial forestry in Norway. From around 1980, forest management has been increasingly influenced by international climate and biodiversity treaties, while changes in legislation have promoted "multiple use forestry" (Halberg, 1999; Hoen et al., 2019). This is also reflected in increased protection of forest areas (NEA, 2019), as well as in the growing recognition of outdoor recreation as an important forest function (MCE, 2018; NEA, 2014). At present, approximately 5.2 % of the total forest area, and 3.9 % of productive forest area, is protected, while the national goal is to protect 10 % of all forest area (MCE, 2013; NEA, 2019; NEA, 2022).

Third, forest dynamics have been affected by population growth and by urbanization. Norway's population grew from 3.2 to 5.2 million during 1950–2020 (SSB, 2019), and the share of population living in densely populated areas increased from 52 % in 1950, to 80 % in 2020 (MLGM, 2018). Consequently, pressure on some peri-urban and urban forest ecosystem have increased.

Finally, cultural drivers are also relevant, particularly in combination with economic drivers. As average working time declined by one third since 1946 (SSB, 2007a), and household consumption more than tripled from 1958 to 2019 (measured in fixed prices) (SSB, 2019), more time and money have been used for travelling, outdoor recreation, and e.g., recreational homes in forest areas.

4.2.2. Direct drivers

We identified changes in forest management, infrastructure development and climate change, as the most important direct drivers of change. Major direct drivers of change are shown in Fig. 3.

First, forests and their services have been deeply transformed by changes in forest management, primarily by the introduction of industrial forestry practices like mechanized even-aged forestry and clear-felling, and by measures of re- and afforestation. Rarely practiced before 1950, clear-felling affects today between 60 and 70 % of the productive forest areas in Norway (Storaunet and Rolstad, 2020). After 1950, large scale afforestation projects were carried out in Western and Northern Norway. Around 4,5% (3900 km^2) of today's productive forests have been afforested over the last 70 years (Tomter and Dalen, 2018). Non-native tree species have been planted on approximately 800 km^2 since 1950 (Tomter and Dalen, 2018). Forest management has become increasingly mechanized, and the share of the timber harvested with machines increased from 4 % in 1978 to 91 % by 2007 (SSB, 2007b).

Second, forests have been transformed through the development of infrastructure like recreational homes, roads, and power lines, which together have led to fragmentation of forest areas and to a significant decline in the share of wilderness-like areas (NEA, 2018). As an example, the average size of recreational homes increased from 62.2 m^2 to 96.2 m^2 between 1983 and 2020, and the demand for infrastructure such as roads, electricity, sewage in relation to recreational homes has also increased (SSB, 2020d). Further, some forest areas such as peri-urban forests, have been deforested as a result of expansion of urban settlements (Breidenbach et al., 2017).

Finally, increases in annual average temperature (approximately 1 °C up from 1900 until 2014) and in annual precipitation (approximately 18 % up from 1900 to 2014) (Norsk Klimaservicesenter, 2017) have contributed to increased forest growth. Further, an increased frequency of extreme weather events such as heavy rainfall, periods of drought, and storms, puts pressure on forest resilience against events of windthrows, forest fires, and landslides (VKM, 2021).

4.2.3. Relationships between drivers of change and ecosystem service trends

Fig. 4 provides a framework (adapted from MEA, 2005) to illustrate the relationship between the drivers of change and ecosystem services

[8] "Wilderness like" nature areas are defined as areas with more than 5 km distance to significant technical interventions. Examples of such technical installations are all types of roads, railways, water reservoirs, power lines and other energy facilities. These areas represent habitat with limited human impact and are thus a relevant indicator for habitat provision.

[9] Scott (1999) argue that scientific forestry/even-aged forestry builds on a "high-modernist" ideology with strong belief in progress of science and technology.

Fig. 2. Major indirect drivers of change affecting forest ecosystem services in Norway, 1950–2020 Sources: (MLGM, 2018; NEA, 2019; SSB, 2019; SSB, 2020a; Tomter and Dalen, 2018).

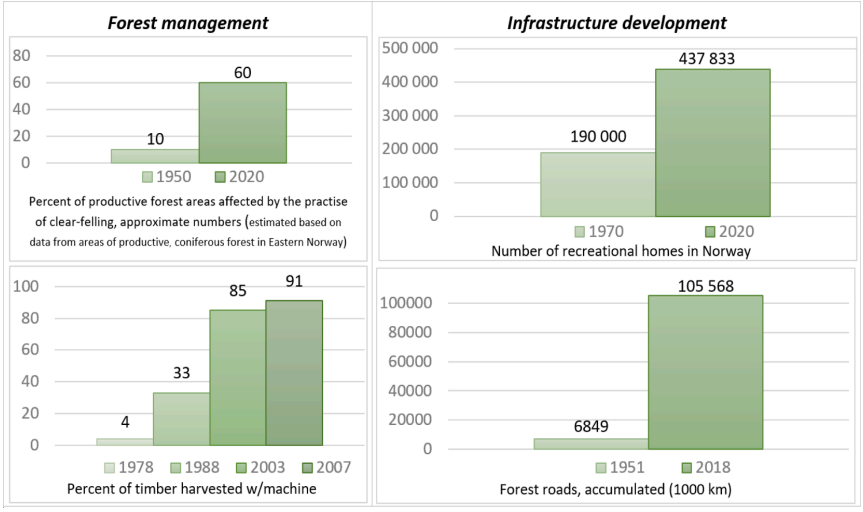

Fig. 3. Major direct drivers of change affecting forest ecosystem services in Norway, 1950–2020 Sources: (NAA, 2021; SSB, 2007b; SSB, 2019; SSB, 2020d; Storaunet and Rolstad, 2020).

trends over the studied period. Overall, we found that economic and sociopolitical factors have been particularly prominent in shaping direct drivers of change, while forest management, infrastructure development, and climate change have been the most important direct drivers. The strength of the direct drivers was established from assessments across indicators, and from discussions in the expert workshop.

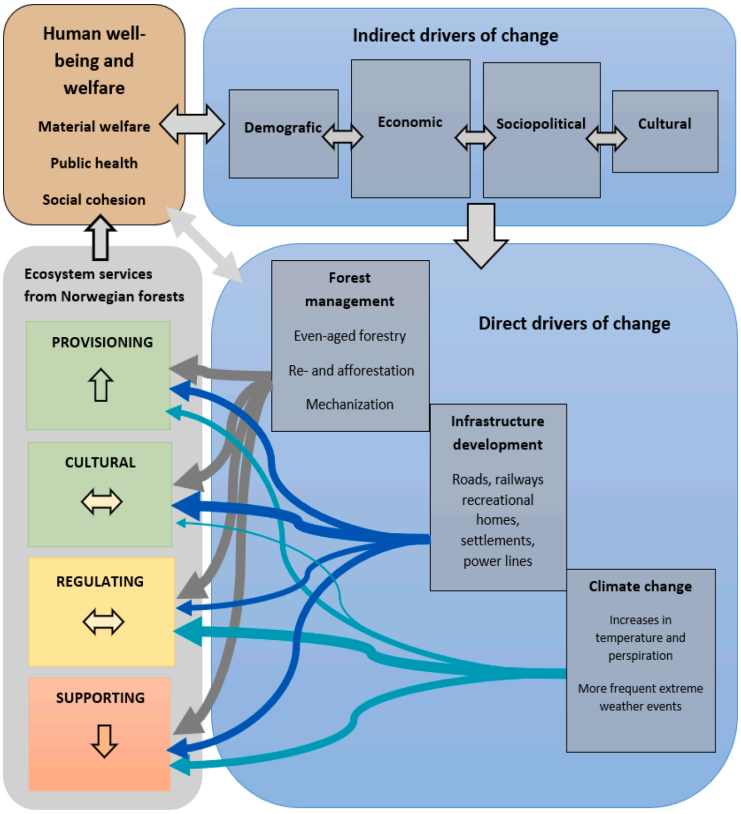

Fig. 4. Conceptual framework illustrating the impact of different drivers of change.
The framework (adapted from MEA (2005)) illustrates how indirect and direct drivers of change have affected trends and condition of ecosystems services from Norwegian forests, 1950–2020. The relative importance of indirect drivers is indicated by different size of the boxes. The arrows going from indirect drivers to the different ecosystem service categories have different color to distinguish them. Different thickness of the arrows going from the direct drivers indicates the degree to which they have affected trends and condition of different categories of forests ecosystem services. In each of the ecosystem service main categories, trends across *capacity* and *flow* are indicated with ↑=increased; ↔=remained stable; ↓=decreased, while forests condition to provide the services is indicated by colors; green (good), yellow (acceptable), red (poor) (see more detailed descriptions in chapter 4.1., in Table 2, and in Appendix 2). (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

Forest management has had strong effects on trends within all main categories of ecosystem services. Infrastructure developments have particularly affected provisioning, cultural, and supporting services, while climate change has had strongest effects on regulating, supporting, and provisioning services.

5. Discussion

Over the study period (1950–2020), forests in Norway have been directly shaped by policies aimed at increasing the supply of provisioning services, mainly through reforestation, afforestation, and intensification of forest management (Tomter and Dalen, 2018). Despite growing attention to biodiversity in recent decades, Norwegian forest management has overall favored provisioning services at the expense of supporting services, and some regulating and cultural services (Lindhjem and Magnussen, 2012). Overall, trade-offs have gone in favor of *efficiency* in the provisioning of timber, at the expense of the *ecological condition* and *resilience* of forest ecosystems.

If growing calls for a stronger role of forests in the bioeconomy come into being (The Norwegian Government, 2016), forests are arguably set to recover, at least partially, its historically important role in the Norwegian economy. The so-called "green shift" towards renewable energy and materials (see e.g. MAF, 2019) is likely to increase the demand for provisioning services from forests, which in turn might increase the pressure on other ecosystem services. A key insight from the ecosystem service framework is that tradeoffs in benefit supply is unavoidable (Turkelboom et al., 2018). Likewise, recent studies show that all desired aims for forest management cannot be achieved simultaneously, illustrating the need to deal with trade-offs associated with different forest functions and services (Krøgli et al., 2020; Lindahl et al., 2017; Triviño et al., 2017).

As an example, forest *resilience* to climate change may be improved by diversifying forests with mixed species of un-even aged trees (VKM, 2021). Further, recent research brings attention to how alternative forest practices, such as continuous-cover forestry (Peura et al., 2018), increased rotation times within forestry (Nordén et al., 2018), and close-to-nature silviculture (Báliková and Šálka, 2022) may enhance a broader array of forest ecosystem services (Pohjanmies et al., 2017). However, such shifts in forest management practices are also likely to reduce *efficiency* related to timber harvest and would depend on deliberate forest policy aimed at the enhancement of regulating and supporting services.

Trends in ecosystem services from Norwegian forests from 1950 to 2020, serve to illustrate that policy measures to increase growth in biomass are not sufficient to safeguard multiple functions and services from forest ecosystem. Comprehensive, biophysical assessments of trends and drivers of change can contribute to identify and explain ecosystem service changes at a national scale, over long periods of time. This can provide an important knowledge basis for policy choices. However, the lack of detail and accuracy of indicators at a national scale, makes this approach less suited as policy tool for prioritizing between specific services at local and regional scale.

Overall, a broader set of indicators are needed to capture and describe changes in forest ecosystem functions and their benefits to humans (Brockerhoff et al., 2017; Pohjanmies et al., 2017). While comprehensive monitoring systems have been put in place to provide relevant data for timber production, it is difficult to find accurate data for regulating and cultural services, at a national scale. Thus, there is a need for improved knowledge and systematic monitoring of indicators

covering regulating and supporting services. Further, the qualitative shift in forest contribution to *sense of place* (from livelihood to recreation), calls for improved understanding of how human-nature relationships may contribute to well-being, and to satisfying human needs (Kaltenborn et al., 2020).

6. Conclusion

Through our assessment of the most important ecosystem services from Norwegian forests, we identified eight main types and ten related subtypes, including two provisioning services, two cultural services, three regulating services and one supporting service.

Over the last 70 years, Norwegian forests have been growing in biomass and extent, but this has occurred in parallel with loss of wilderness-like areas, deforestation of forest areas close to settlements, and an increasing share of clear-felled forests. These trends are consistent with international reports signaling fragmentation and changes in functions in boreal and temperate forests (Díaz et al., 2019; Gauthier et al., 2015).

Further, and in line with results from IPBES's global ecosystem assessment (IPBES, 2019), our results indicate that pressure from economic, sociopolitical, demographic and cultural drivers have accelerated over the past 50 years. Economic and sociopolitical drivers have been particularly prominent at shaping forests and forest ecosystem services, both in establishing even-aged forestry as a dominant management practice, and by facilitating infrastructure development in forest areas (e.g., roads and recreational homes).

These changes entail both increases and declines in different forest ecosystem services, and there are uneven trends across ecosystem service categories. Infrastructure expansions have increased pressure on forests, while also enhanced opportunities for outdoor recreation through increased access and enabling infrastructure. However, in line with the MEA (2005), we find that forests' capacity to provide some important *regulating* and *supporting* services are in decline.

We argue that broad and interdisciplinary assessments of trends in forest ecosystem services at a national scale that integrate ecological, economic, and social information can provide valuable insights for governments to inform their forest policies, e.g., by helping policy makers to identify priority areas. Our assessment provides one such approach to identify and explain trends of ecosystem services, over a long period of time. Our results suggest the need to develop a broader set of indicators to guide national forest policy in Norway and beyond. However, forest policies are not made in isolation from other drivers in society. The strong influence of economic and sociopolitical drivers in shaping trends of forest ecosystem services indicates support for the call for *transformative societal changes* to protect and sustainably use nature (IPBES, 2019).

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data sources included scientific papers and reports, policy documents, books, and data from official national statistics. All data sources are listed as references in the article.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ecoser.2022.101491.

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Article 2

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Unveiling imbalanced investments in forest ecosystem services

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Abstract

Ecosystem services that are not traded in markets are often relegated to services with established markets, and economic instruments can be used to balance uneven ecosystem service trends. We use Norway as a case study to examine the role of economic instruments in stimulating forests capacity to supply different ecosystem service. Specifically, we i) map the most important economic instruments in Norwegian forest governance, targeted ecosystem services, and associated scales of investments, and ii) examine how existing economic instruments promote or constrain ecosystem services capacity. Data was collected from a review of policy documents and fiscal budgets, as well as from most recent data for status and trends of ecosystem services from Norwegian forests. Three main results are highlighted. First, the main economic instruments in Norwegian forest governance are markets for forest products and amenities, forestry certification schemes, and government expenditures such as subsidies for timber and payments for forest conservation. Second, markets for timber (578 mill €/y) and hunting licenses (74.1 mill €/y) amount to gross revenues of around 652.1 euros per year. Moreover, subsidies, tax reliefs, and PES-schemes primarily target habitat provision (43.44 mill €/y), timber (38.17 mill €/y), and carbon sequestration (2.53 mill €/y). Third, except for payments for voluntary forest conservation, most instruments target services for which forests already have increasing capacity. By contrast, other services with declining or stable trends, such as sense of place and nutrient cycling, are sidelined, or even undermined by instruments targeting timber production and carbon sequestration. Our results suggest that major reallocation of investments and expenditures will be required to diversify and balance capacity for supply of a broader array of forest ecosystem services.

Key words: economic instruments, ecosystem service capacity, tradeoffs, forest governance Norway.

1. Introduction

Global assessments show that ecosystem services that are not traded in markets (typically regulating and supporting services) are relegated to material goods and amenities with established markets (MEA, 2005; TEEB, 2010). However, decline in regulating and supporting services will eventually degrade capacity for all services (ibid.), and it is important to design economic instruments that safeguard ecosystem services diversity (Martín-López et al., 2014; Ring & Barton, 2015; Turkelboom et al., 2018). The global Aichi Biodiversity targets emphasize a reform of economic incentives, specifying that instruments with negative effects on biodiversity were to be phased out by 2020, whereas positive incentives for the conservation and sustainable use of nature were to be developed and applied (CBD, 2010). Recent policy reports, however, suggest that much work remains to be done globally to eliminate or reform economic instruments like "subsidies, financial transfers, subsidized credit, tax abatements, and prices for commodities and industrial goods that hide environmental and social costs" (IPBES, 2019:30).

Forest ecosystems provide a wide range of services such as habitat for biodiversity, timber, climate mitigation, and outdoor recreation (Brockerhoff et al., 2017; Gauthier et al., 2015; Jenkins & Schaap, 2018; Mengist & Soromessa, 2019; Shvidenko & Gonzalez, 2005). Sustainable forests governance ranks high on the political agenda in Europe. For example, the European Union intends to promote sustainable forestry through the EU forest strategy 2030 (EU, 2021), and the EU Taxonomy Compass for Sustainable Finance (EU, 2022). However, although forest cover is increasing in Europe (FAO, 2020), forests' capacity to provide many cultural, regulating and supporting services are declining due to e.g. fragmentation and cumulative anthropogenic impacts on forest functions (see e.g., Díaz et al., 2019; Lindhjem & Magnussen, 2012; Pukkala, 2018; Savilaakso et al., 2021).

Here, we combine an analysis of policy documents and fiscal budgets with data from recent ecosystem service assessments, to examine the relationship between economic instruments and the status and trends in forest ecosystem service capacity. We use investment volumes embedded in the instruments as a proxy for the importance attributed to different forest ecosystem services in markets and in government expenditures. Specifically, we i) map the most important economic instruments in national forest governance, targeted ecosystem services and associated scales of investments, and ii) examine how existing economic instruments promote or constrain forests capacity to supply different ecosystem services.

Norwegian forest governance is used as a case study. In Norway, provisioning ecosystem services (material goods such as food and timber) have long been favored at the expense of other ecosystem services such as habitat, regulatory, and cultural benefits from forest ecosystems (Helseth et al., 2022; Lindhjem & Magnussen, 2012). Consequently, Norwegian forests have increased their capacity for providing raw materials, while capacity to sustain other ecosystem services such as moderation for extreme events or habitat provision have declined (Framstad et al., 2021; Helseth et al., 2022).

To enhance biodiversity in forests, the Norwegian government has implemented payments for 'voluntary forest conservation' (Frivillig Vern, 2022, first initiated in 2000). However, this payment for ecosystem services (PES)-like scheme adds to a complex policy mix that includes long-standing subsidies for timber production, as well as more recent measures to increase carbon sequestration (Magnussen et al., 2020; Tomter & Dalen, 2018). Over the last decade, several assessments have

recommended that economic instruments with negative impact on biodiversity should be removed or reformed in order to enhance a broader array of ecosystem services (Magnussen et al., 2020; NOU 2013:10, 2013; OECD, 2022). However, few of these recommendations have materialized in concrete policies (see e.g., OECD, 2022), and the uneven trends in capacity for forest ecosystem service in Norwegian forests presents an interesting case for examining tradeoffs from the application of economic instruments.

2. Background

2.1. Economic instruments for ecosystem service governance

In recent decades, environmental governance has expanded its primary focus from enhancing material resources (such as timber) to addressing a wider range of nature's benefits, from the regulation of air, water, and soils, to concerns over biodiversity, and to the provision of cultural and intangible benefits such as recreation (Gómez-Baggethun et al., 2010; MEA, 2005; TEEB, 2010). Such benefits from nature are increasingly described as *ecosystem services*, often categorized as either *provisioning*, *cultural*, *regulating*, and *supporting* services (ibid.).

Recent trends in ecosystem services research differentiate ecosystem service capacity from ecosystem service flow and demand (Baró et al., 2016; Helseth et al., 2022; Villamagna et al., 2013). Ecosystem service *capacity* is defined here as "an ecosystem's potential to deliver services based on biophysical properties, social conditions, and ecological functions" (Villamagna et al., 2013:116). For example, forest accessibility and attractiveness have a positive influence on forest capacity to provide outdoor recreation, while standing biomass or forest cover correlate with capacity for timber or bioenergy (Burkhard et al., 2014; Villamagna et al., 2013). *Capacity* thus expresses potential supply of ecosystem services, while *flow* or *demand* indicate respectively the actual and desired use of ecosystem services (Baró et al., 2016; Burkhard et al., 2014).

Ecosystem service governance happen through complex policy mixes, including i) *economic-*, ii) *regulatory-*, and iii) *informational/motivational instruments* (Ring & Barton, 2015:415). 'Economic instruments' can be broadly defined as incentives aimed at making economic actors (such as firms and consumers) reduce environmental damages and/or protect nature (see e.g., Buckley & Buckley, 1991; Panaiotov, 1994; Ring & Barton, 2015). However, economic instruments may also promote activities that are harmful to nature, and The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) emphasizes how "economic incentives have generally favored expanding economic activity, and often environmental harm, over conservation or restoration" (2019:14).

With regard to typologies of instruments, Vatn makes a distinction between markets and taxes/subsidies and propose to use 'economic instruments' "as the common term for any situation where payments are used. Taxes, (user) fees, subsidies, donations and trades would then all be sub-categories of this wider concept" (Vatn, 2015:228). Vatn specifies that 'environmental taxes' "imply putting a cost on damaging nature", while 'environmental subsides' "are paid for delivering environmental services/ reducing damages" (Vatn, 2015:228). Markets are defined: "a 'place' were goods and services are traded between producers and consumers against a payment" (Vatn, 2015:196). Here, markets are understood as institutional systems, shaped by the processes that transform goods and services into commodities (tradable units), and dependent on a variety of

institutions such as: i) property rights, ii) money, iii) measurements scales, iv) and other constructs such as e.g., firms and banks (ibid.).

Although many provisioning and cultural ecosystem services, such as timber or recreational amenities, have established markets, market prices fail to reflect so called externalities, i.e. uncompensated costs and benefits resulting from market transactions that are born by third parties (IPBES, 2022; TEEB, 2010). In this regard, economic instruments are often framed as tools aimed at internalizing external costs and benefits into economic transactions in order to enhance environmental protection. From this approach, economic instruments can be divided in two broad categories (Gómez-Baggethun & Ruiz-Pérez, 2011). The first category follows the 'polluter pays principle' and consists of mechanisms for reducing or compensating environmental costs. Instruments in this category include environmental taxes, biodiversity offsets and carbon markets. The second category follows the 'provider gets principle' and consist of schemes to promote and reward non-market environmental benefits such as carbon sequestration, water regulation, and habitat provision. Instruments in this category include ecolabelling and the various reward schemes characterized as payments for ecosystem services (PES) (see e.g., Vatn, 2015).

2.2. Norwegian forest governance

Norwegian forests cover more than one third (37%) of the national land area[1], and consist of a mix of Norway spruce (27.3%), Scots pine (29.6%), and birches and other boreal deciduous trees (40%) (NIBIO, 2020b). Around 70% (82 800 km^2) of Norwegian forests are classified as 'productive' i.e. defined as forest with a production of at least 1 m^3 timber per hectare per year (SSB, 2023a). The Norwegian government has long used regulatory measures and economic instruments to stimulate timber production (Bækkelund, 2020). Consequently, biomass in Norwegian forests has tripled over the last 100 years (NIBIO, 2019), mainly a result of a state-led policy mix incentivizing re- and afforestation and even-aged stand management with clear-felling[2] (NIBIO, 2019; Tomter & Dalen, 2018). An example of regulatory measures is the 'duty of rejuvenation', which obliges forest owners to promote 'forest rejuvenation' (primarily through re-planting) within three years after a timber harvest (Lovdata, 2006).

Three-quarters (77%) of the productive forest areas in Norway are privately owned (Statskog, 2015), including 124 551 properties above 2.5 ha. (SSB, 2023a). Forest owners hold rights to forestry and hunting while the 'Right to Roam' grants all people access to forests, including rights to harvest wild plants, berries, and mushroom (Reusch, 2021). Since the 1950s, many forestry-based livelihoods have been restructured to promote more efficient, and large-scale timber production (Kaldal, 2022). Mechanization reduced employment in the forestry sector from 28500 people in 1950 to 6600 in 2018, while most forest owner organizations have become larger commercial enterprises through mergers and geographical expansion (SSB, 2015; SSB, 2021; Tomter & Dalen, 2018). Today, entrepreneurs are responsible for most timber harvest, in cooperation with forest owners' companies (ibid.).

[1] The Norwegian mainland is 323 808 km^2 (Thuesen, 2023).
[2] In 1938, the Norwegian government adopted a forestry plan of reforestation, designed around intensive, even-aged forestry (Bækkelund, 2020).

Forestry contributes 0.2% to Norwegian GDP (as compared to 2.5% in 1950) (SSB, 2021), and in 2022 the gross value of timber for industrialized purposes was 578 million euros[3] (NAA, 2023b). Moreover, the Norwegian government estimates that added value from wood processing industry is more than 10 times the direct timber price, and forests are seen as key renewable resources in national plans to develop a "bioeconomy" (MAF, 2016; The Norwegian Government, 2016).

Norway has sizeable markets for bioenergy and for amenities, such as hunting and recreational homes (Andersen & Dervo, 2019; NIBIO, 2018; NIBIO, 2020a; SSB, 2023b; Strand et al., 2021; Sverdrup-Thygeson & Framstad, 2007). Furthermore, Norwegian forests offset close to half of the national carbon emissions (NEA et.al., 2017), and provide home to about half of the endangered species in Norway (Artsdatabanken, 2021). Over recent decades, the Norwegian government has reformed policies and legislation to enhance a broader range of forest ecosystem services and functions (Hoen et al., 2019; Sverdrup-Thygeson et al., 2014), while the Norwegian forestry sector has committed to the use of forest certification schemes (FAO, 2020; Tomter, 2023). About 5.5 % of the total Norwegian forest area is protected[4], and the government aims to use a PES-scheme of voluntary protection to increase the share of protected forests to 10% (Frivillig Vern, 2022; NEA, 2019; NEA, 2022).

Despite such measures, the ecological condition of Norwegian forests is relatively poor, due e.g., to intensive forestry practices and infrastructure developments (Framstad et al., 2022). The Norwegian Nature Index, based on a large number of indicators representing different aspects of biodiversity, indicates that biodiversity status in Norwegian forest ecosystems has a references value of 0.41, against an optimal score of 1[5] (Storaunet & Framstad, 2020). A recent assessment of trends and condition of forest ecosystem services in Norway shows that forest capacity and supply of provisioning services has increased over the last 70 years, while capacity for habitat provision and moderation of extreme events has been declining (Helseth et al., 2022). Thus, policy mixes to enhance common goods from forests, including economic, regulatory, and informational instruments (Ring & Barton, 2015) have so far failed to curve negative trends in regulating and supporting services (see e.g., Barton et al., 2013; Framstad et al., 2022; Sverdrup-Thygeson et al., 2014). If Norwegian forest governance is to align with aims of national and international calls for sustainable forest use, there is a need for improved knowledge of the ecosystem service tradeoffs involved in the application of specific economic instruments.

[3] Norwegian kroner (NOK) to euro (€) are calculated by the exchange rates from the 31st of December 2021 (1 NOK = 0.0997 euro). Due to historically low exchange rate the last two years, our figures give conservative estimates.

[4] Estimates show that around 30 % of the productive forest area is affected by different kinds of restrictions (Søgaard et al., 2012).

[5] The reference value has remained relatively stable over the time period covered by the Nature Index (1990-2020).

3. Methodology

Data were collected from a review of policy documents and fiscal budgets, cross checked with data from recent ecosystem assessments of Norwegian forests.

3.1. Data collection

To assess tradeoffs in forest benefits from the application of incentives we mapped economic instruments in forest governance and the ecosystem services they target, and then contrasted this information against data on ecosystem service condition and trends. To map economic instruments we reviewed policy documents, fiscal budgets, and previous research on economic incentives in Norwegian environmental policy (Kvakkestad et al., 2012; Magnussen et al., 2020; NOU 2013:10, 2013). Data from condition and trends in forest ecosystem services where derived from a review of previous ecosystem assessments of Norwegian forests (Berglihn & Gómez-Baggethun, 2021; Helseth et al., 2022; Lindhjem & Magnussen, 2012).

3.2. Classification and characterization of economic instruments

Following Vatn we classified economic instruments[6] into four main groups, including i) markets for ecosystem services, ii) forest certification schemes, iii) subsidies, tax reliefs and taxes, and iv) payments for ecosystem services (see e.g., Vatn, 2015). For the purpose of this research, we considered as relevant instruments those directly targeting one or more forest ecosystem services. Examples include incentives to economic actors involved in management (including conservation) and infrastructure developments in forest areas (such as subsidies for forest roads). We excluded economic instruments not directly targeting any forest ecosystem service, such as infrastructure developments that affects forests in indirect forms, e.g., subsidies for public roads[7]. We also excluded direct public investments such as the purchase of private land to safeguard public access to recreation areas (see e.g., NEA, 2020).

We limited our analysis to economic instruments in force in 2022, including those featuring in the Norwegian fiscal budget. Where data was available, we also assessed trends in the economic volume of the instruments over the last decade.

We assessed the *ecosystem services targeted* by each instrument from a review of policy documents and economic data sources. For ecosystem service markets, the targeted services were identified as those most closely associated with the commodity traded in the market. For example, timber markets target raw materials/ timber, while sale of hunting licenses may target both food and recreation. To elicit the targeted services of forest certifications, we reviewed the guidelines and requirements guiding these schemes. Lastly, the targeted services of subsidies/ tax reliefs, taxes, and PES-like schemes were retrieved from descriptions in annual budgets (2022) of the Ministry for Agriculture and Food [MAF] and of the Ministry for Climate and Environment [MCE].

[6] We note that many economic instruments are part of policy mixes in which legislations also play important parts. As an example, the maintenance of so called “protection forests” (forest that is planted or saved as protection for other forests, or as protection against natural hazards) is mandatory through the Forestry Act (Hofstad & Dalen, 2023). Such legislations can impose costs on economic actors.

[7] These categories may overlap, e.g., when the standards of public roads are improved partly to accommodate for timber transport.

We adopted different approaches to quantify the money flows mobilized within each category of economic instruments. For ecosystem service markets, we quantified gross revenue from direct trade of relevant commodities, such as timber and hunting licenses. We excluded some markets from the assessment, due to lack of data, or ambiguity in their relation to targeted forest ecosystem services. For example, we excluded the sale of plots for recreational homes in forests, due to uncertain data on the share of such plots located in forest areas. Also, although Norway has sizeable markets for meat from grazing animals, we did not find data on economic volumes specific of *forest pastures*. Added value through commodity chains in ecosystem service markets (such as revenues from the wood processing industry) were also excluded, due to a less direct relationship to the assessed ecosystem services, and to reduce risks of 'double-accounting'. Our estimation of market value is thus a conservative one. We assessed the monetary flows mobilized by forest certification schemes through estimates of expenses imposed on economic actors for environmental considerations, such as preservation of habitats. Although such certifications schemes also promote higher timber prices, we did not find data specifying this effect. Finally, investments mobilized through fiscal budgets were proxied via government expenditure through taxes, subsidies, and tax reliefs. To specify money flows targeting each service, we used data on subsidies or tax reliefs allocated to different measures as of 2022 (NAA, 2023e).

3.3. Assessing how economic instruments promote or constrain ecosystem service capacity

Economic instruments work as indirect drivers of forest change by influencing management choices, which in turn affect forests capacity to supply ecosystem services (see Figure 1). Following Turkelboom et al. (2018), we define *ecosystem service tradeoffs* as "land-use or management choices that increase the delivery of one (or more) ecosystem service(s) at the expense of the delivery of other ecosystem services". Such tradeoffs may also happen between *capacity* or use (*flow*) of the same service, for example if the use of a service is higher than the capacity (Baró et al., 2015).

Thus, while economic instruments target specific ecosystem services, they may also engage in tradeoffs through inducing negative or positive side effects on forests capacity to provide the same or other services. Such consequences may be unintended or unknown to policy makers, and they are typically not specified in the aim of the instruments. For example, subsidies for nitrogen fertilization to increase carbon sequestration may have negative effects on forest capacity for habitat provision and nutrient cycling (Magnussen et al., 2020; Aarrestad et al., 2013).

To assess how economic instruments promote or constrain forest capacity to provide ecosystem services, we drew on indicators and data from a recent biophysical assessment of ecosystem services from Norwegian forests (Helseth et.al, 2022) (see indicators of ecosystem service capacity in Table A.1. in Appendix A).

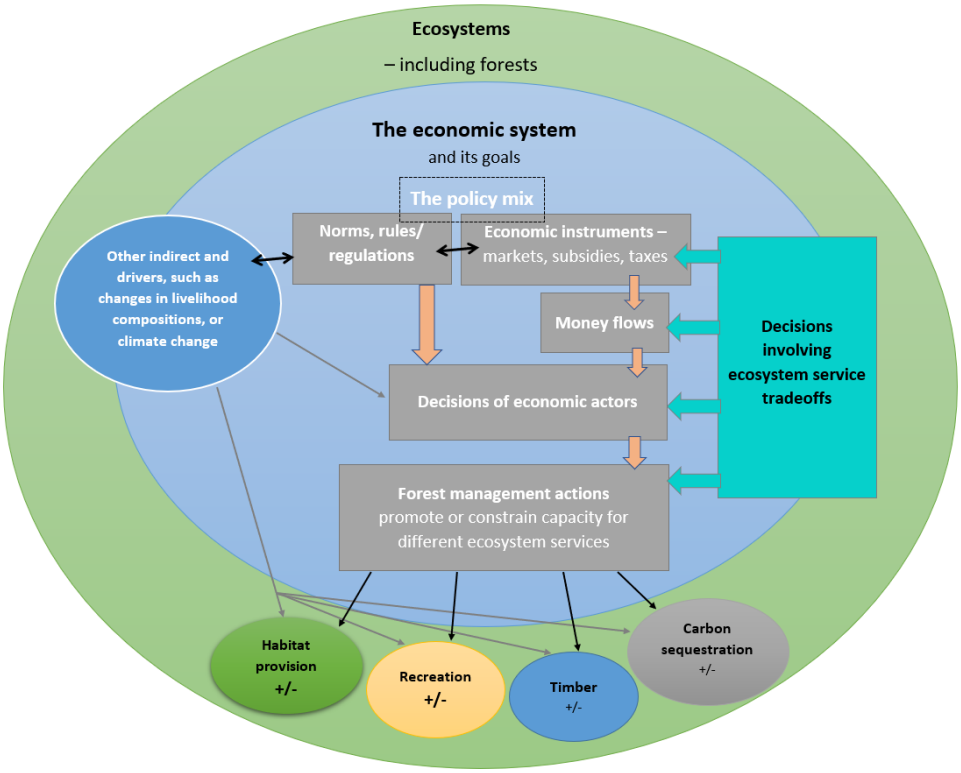

Figure 1: Economic instruments and ecosystem service tradeoffs. *The diagram illustrates how economic instruments work as part of a broader policy mix (indirect drivers) that influence forest management choices (direct drivers), which can in turn promote or constrain forests capacity to provide different ecosystem services.*

Information about targeted ecosystem service(s), as well as associated money flows, provide indications of intended or expected effects of the economic instruments on indicators for capacity, but provide no proof of a direct causal effect. We thus limit our analysis to define the expected direction of how economic instruments work to either promote or constrain capacity for different forest ecosystem services. Data on expected effects are cross checked with data on status and trends of ecosystem services capacity in Norwegian forests, which allows to assess correlations, while not causality.

4. Results

First, we present an overview of the most important economic instruments, the targeted ecosystem services, and the associated money flows. In the second section, we discuss the role of each instrument in promoting or constraining forest capacity for different services.

4.1. Economic instruments, targeted ecosystem services, and scale of investment

The most prominent economic instruments in Norwegian forest governance include i) markets for provisioning and cultural ecosystem services, ii) forest certification schemes through PEFC and FSC, iii) subsidies and tax reliefs, and iv) payments for forest conservation (Table 1). For detailed description of each of the assessed instruments, see Table 2.

Table 1: Main economic instruments and related money flows in Norwegian forest governance

Economic instrument	Operation and targeted ecosystem services	Economic value in million euros	Total
Markets for ecosystem goods and services	Timber markets (raw material/ timber)	Gross value (2022): 578	
	Sale of hunting licenses for wild ungulates (recreation and food)	Gross value (2018): 74.1	
			Markets: 652.1
Forestry certification schemes	Norwegian PEFC forest standard (Programme for the Endorsement of Forest Certification) and FSC (Forest Stewardship Council) (raw material/ timber, habitat provision, recreation)	Costs imposed (2018)	FCS: 10.57
Subsidies and tax-reliefs	Silviculture (raw material/ timber)	8.66	
	Environmental measures (habitat provision)	0.24	
	Forest planning with environmental registration (raw material/ timber and habitat provision)	2.35	
	Forest roads and harvesting in difficult terrain (raw material/ timber)	13.75	
	Timber-harbors (raw material/ timber)	2.8	
	Denser planting and fertilizing (carbon sequestration)	2.53	
	Tax reliefs through Forest Fund (90% used for silviculture and forest roads, 0.01% for environmental measures) (raw material/ timber, habitat provision)	12.96	
			Subsidies and tax reliefs: 43.3
Payments for forest conservation (PES)	Payments for voluntary conservation of forests (habitat provision)		PES: 43.44
			All instruments: 749.4

Sources: (Andersen & Dervo, 2019; Lindhjem & Magnussen, 2012; MAF, 2016; MAF, 2022; MCE, 2021; NAA, 2023c; NAA, 2023e; SSB, 2022). Numbers used for subsidies, tax-reliefs, and PES are all from 2022.

Table 2. Description and application of the economic instruments

Economic instrument	Targeted services and background info	Application/ money flows	Sources
Timber markets	Efficient allocation of timber is the guiding principle in timber markets, and international timber prices have a strong influence on Norwegian timber harvest.	In 2022, 11.5 million m^3 of timber was harvested for sale[8], while the gross value of timber sale amounted to 578 million euros.	(NAA, 2023a; NAA, 2023b; The Norwegian Government, 2018; Tomter & Dalen, 2018)
Markets for wild ungulate hunting licenses	Forests owners hold hunting rights on their forest property, while the quotas of hunting licenses are regulated by national and local authorities, based on indicators for condition in the animal population. Populations of wild ungulates like deer and moose have been increasing over the last 70 years and are today considered to be high and vital.	In 2018, revenues from sale of licenses for hunting wild ungulates was estimated to 74.1 million euro.	(Andersen & Dervo, 2019; Hjortevilt, 2023; Kirkemo et al., 2020; Lovdata, 2022; NEA, 2023; SSB, 2020).
Forest certification schemes	Norwegian forestry has adopted forestry certifications schemes such as the PEFC forest standard and FSC. Most forest property with active forestry since 2000, are included in the PEFC-certification[9]. Certifications entail requirements for forest management, and criteria guiding forest certifications are developed in dialogue with civil society actors such as NGOs.	Recent estimates suggests that additional costs of complying with certification requirements amount to 7.87 million €/year for entrepreneurs, 2.3 million €/year for forest organizations, and 0.4 million €/year for forest-based industry business	(FAO, 2020; NRK, 2023; Sverdrup-Thygeson et al., 2014; Tomter & Dalen, 2018; Tomter, 2023; Aamodt, 2018)
Subsidies and tax reliefs	MAF provide subsidies and tax reliefs targeting specific forest ecosystem services. First, subsidies for *silviculture* target timber production through measures of forest planting and thinning. Second, subsidies to *forestry infrastructure* and *harvesting in steep terrain* target timber production. Subsidies targeting *carbon sequestration* are aimed at stimulating denser forest planting and forest fertilization. A special arrangement called "Forest Fund", provide forests owners with tax releases to reduce their costs for a wide array of forest management measures.	In 2022, 8.66 mill. euros were paid in subsidies for silviculture, and 0.24 mill euros to environmental measures. Subsidies specifically targeting *carbon sequestration* amounted to 2.53 mill. euros in 2022, while 13.75 mill. euros were granted to forest roads and harvesting in steep terrain, and 2.8 mill euros to timber docks- and terminals. Forgone tax incomes to the Norwegian state through Forest Funds[10] amounts to around 12.98 million euros per year.	(Aspøy & Helseth, 2022; Lovdata, 2009; Magnussen et al., 2020; MAF, 2022; MAF, 2023c; MAF, 2023d)
PES-scheme of voluntary forest conservation	Forest owners offer areas for conservation, and the County Governor and NEA select which areas that are allocated, e.g., based on considerations of ecological indicators. The conservation agreement is a contract in which the forest owner permanently give up the right to forestry on the relevant property, while the forest can still be used for e.g., animal grazing, harvesting food, or hunting. Payments are calculated based on the opportunity costs incurred in terms of loss from timber production.	Payments for 'voluntary forest conservation' are annually budgeted by the MCE, and in 2022 they amounted to 37 mill euros.	(Barton et al., 2013; Frivillig Vern, 2022; MCE, 2021; Sverdrup-Thygeson et al., 2014)

[8] In addition to harvests of timber for sale for industrial purposes, it is estimated that 2.1 mill m^3 was harvested for use as fuelwood (SSB, 2023c). We did not find aggregated national data on money flows from sale of fuelwood from Norwegian forests.

[9] This amounts to approximately 40 000 forest properties, and around 7.3 mill ha. of forests (Tomter & Dalen, 2018)

[10] 89.3% of these funds are used for measures that promote timber production.

Markets for ecosystem goods and services concentrate the bulk of monetary flows, amounting to a value of 652.1 million €/year, followed by payments for forest conservation (43.44 million €/year), subsidies and tax reliefs primarily targeting timber production (38.17 million €/year), and costs related to forestry certifications (10.57 million €/year), all of which range within one order of magnitude lower.

A comparison of ecological and economic data shows that – except for payments for voluntary forest protection – the most sizeable economic flows target ecosystem services that have growing trends and overall good condition, while failing to target ecosystem services with declining trends or moderate to poor condition (Figure 3). We did not find any economic instruments targeting the ecosystem service *sense of place*, or the regulating services *moderation of extreme events* or *nutrient cycling*, which indicate an underinvestment in these services by existing markets and government expenditures.

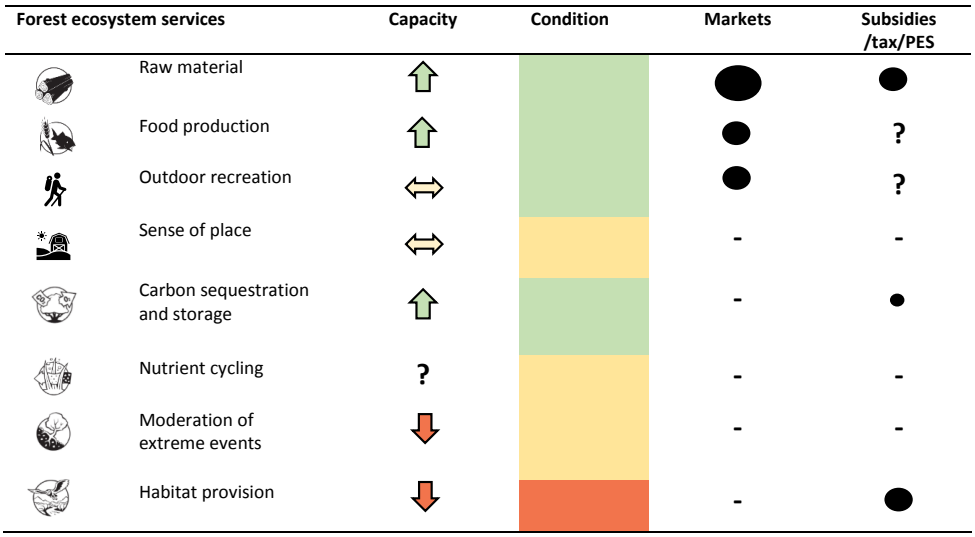

Figure 3: *Trends in capacity of Norwegian forest ecosystem services (1950-2020), condition, and size of markets and allocations in 2022. Figure adapted from (Helseth et al., 2022). Large circle > = 100 mill. euros, medium circle = between 10 – 100 mill. euros, small circle < = 10 mill euros.* ***?*** *= uncertain, and* ***-*** *= no market or government expenditure identified*

Government expenditures through economic instruments such as subsidies, tax reliefs, and PES-like schemes, specifically target the forest ecosystem services of i) habitat provision (43.68 million €/year), ii) timber (38.17 million €/year), and iii) carbon sequestration (2.53 million €/year). Figure 4 gives an overview of trends in the size of these expenditures over the last decade (2013 - 2022). We find that that government expenditure targeting timber production is of similar size as that targeting habitat provision.

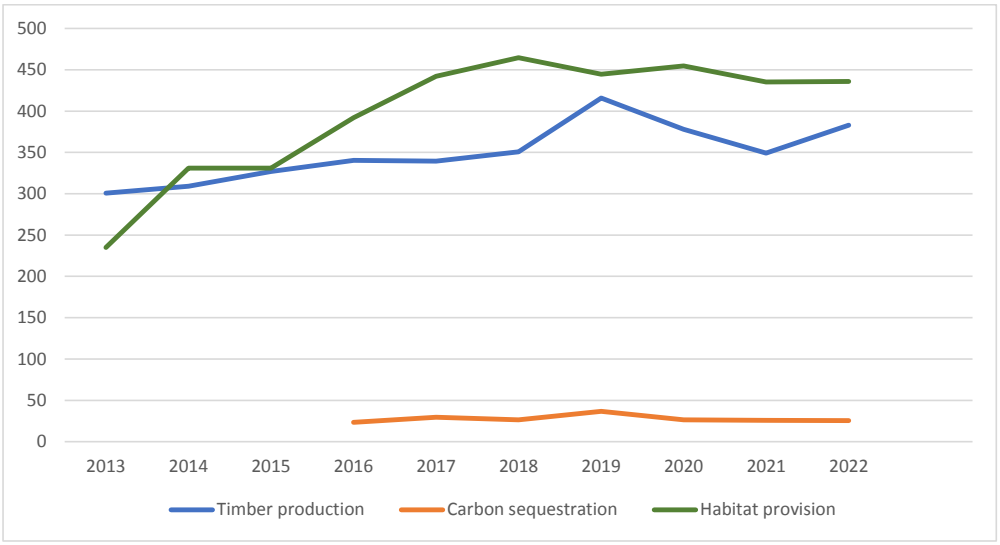

Figure 4: *Government expenditure through economic instruments targeting specific forest ecosystem services, 2013-2022. Sources (MCE, 2021; NAA, 2023e). Million NOK is used as currency for this overview (y-axis), as the main purpose is to show size of expenditures in relation to each other (which remains the same in euros).*

We did not identify any *taxes* targeting the recovery of declining ecosystem services, which indicate that the 'polluters pay principle' is scarcely utilized in Norwegian forest governance. The majority of the assessed instruments follow a 'provider gets principle', which coincides with the 'more-of-everything' forest policy approach in other European countries (Lindahl et al., 2017a; Lindahl et al., 2017b), and with the apparent lack of perceived 'limits to growth' in connection to forests (Edwards et al., 2022).

4.2. Economic instruments and ecosystem service capacity

Figure 5 provide indications of how the different economic instruments promote or constrain forests capacity to provide an array of ecosystem services (based on indicators for ecosystem service capacity, Appendix A.1.).

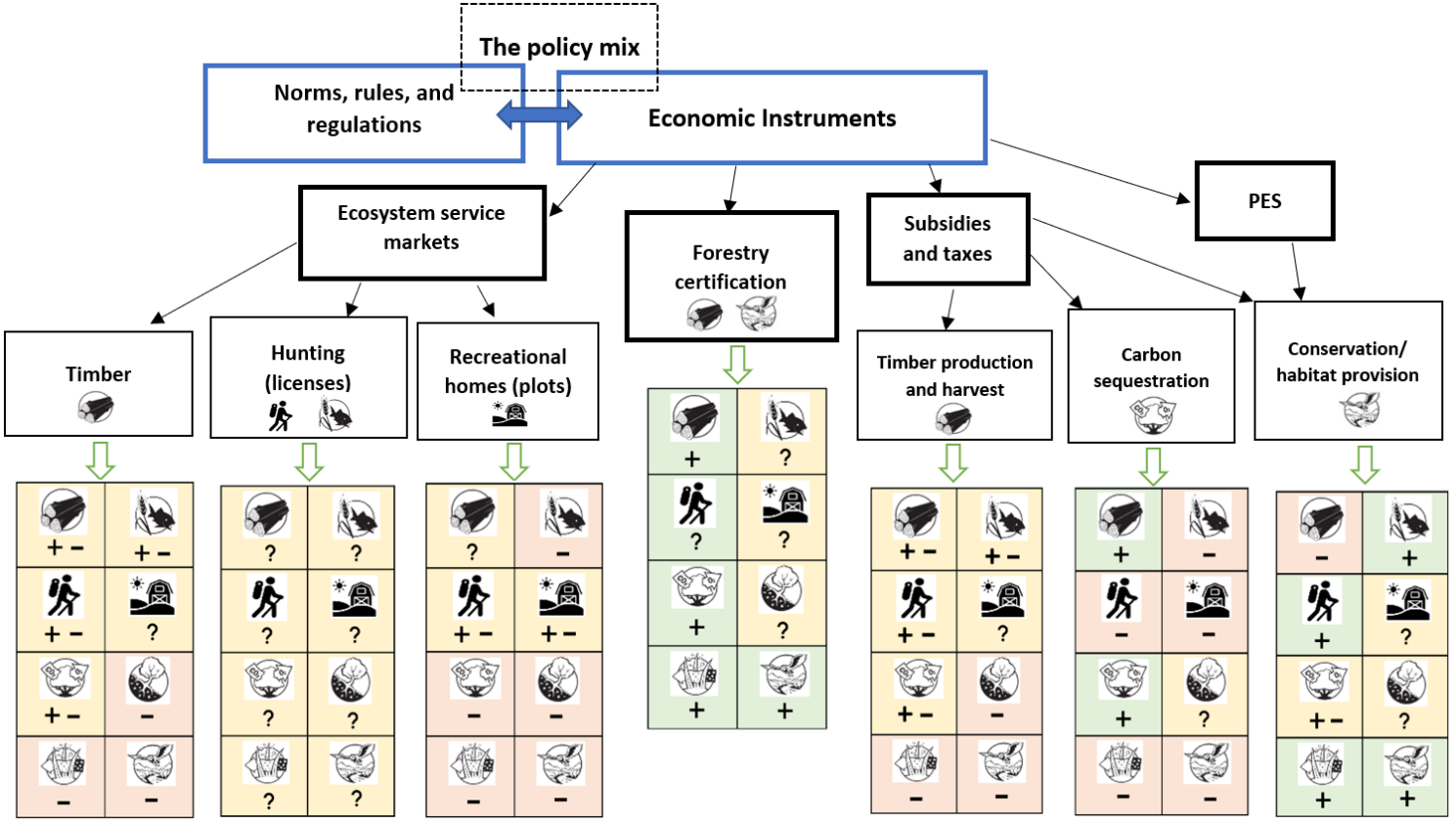

Figure 5: *Economic instruments promoting or constraining forest capacity to provide different ecosystem services. The main services targeted are indicated inside the boxes of each type of economic instruments. Colors indicate how each type of instrument promote or constrain capacity for provisioning of different forest ecosystem services (icons).* ***+*** *= promote (green),* ***-*** *= constrain (red),* ***?*** *= uncertain (yellow), and* ***+/-*** *= can both promote and constrain (yellow). Main sources: Barton et al. (2013); Berglihn and Gómez-Baggethun (2021); Framstad et al. (2022); Frivillig Vern (2022); Helseth et al. (2022); Magnussen et al. (2020); (NAA, 2023e); Sverdrup-Thygeson et al. (2014); Tomter and Dalen (2018); Tomter (2023).*

4.2.1. Markets for ecosystem services

Timber markets
Timber markets promote investments to increase forest biomass for future harvest. However, through stimulating growth in immediate harvest (flow), timber markets can also cause mismatches in capacity and flow. Moreover, by promoting efficient timber production through intensive even-aged forestry with clear-felling, timber markets are likely to constrain forests capacity for habitat provision, nutrient cycling, and moderation of extreme events (see e.g., Framstad et al., 2022; Helseth et al., 2022). As timber prices do not reflect negative impacts on supply of other ecosystem services, schemes of forest certification have been introduced to account for such 'externalities' (see section 4.3.). Intensive forestry may promote capacity for food production, recreation, and carbon sequestration, e.g., through pastures for wild ungulates in clear-felled forests, enabling infrastructure, or biomass growth. However, intensive forestry may also constrain the same service, for example through denser forest that are unattractive for recreation, or through reduced carbon sequestration due to timber harvest (see Gundersen & Frivold, 2008; Helseth et al., 2022; Lindhjem & Magnussen, 2012).

Markets for wild ungulate hunting licenses
Hunting quotas are regulated based on indicators for condition in the animal population (Lovdata, 2022; NEA, 2023). It is likely that number of animals hunted would be the same independent of markets, and that sale of hunting licenses primarily entail that someone else than the forest owner gets to do the hunting. Such markets provide access to more hunters (an indicator of ecosystem service *flow*), but as the number of licenses is predetermined, it is uncertain whether the actual sale of such licenses cause physical interventions in forests functions in ways that affects forests *capacity* to supply timber, food, moderation of extreme events, nutrient cycling, recreation, and sense of place.

4.2.2. Forest certification schemes

In terms of ecosystem services tradeoffs, certification schemes promote increased capacity for timber production and carbon sequestration. Through encouraging specific measures to safeguard biodiversity and outdoor recreation, certifications also promote nutrient cycling, habitat provision, and recreation (Tomter, 2023). We did not find indications on how certification schemes specifically work to promote or constrain forests capacity to supply food, sense of place, or moderation of extreme events.

4.2.3 Subsidies and tax reliefs

The subsidies and tax reliefs targeting *timber production and harvest* promote intensive forestry and increased infrastructure development in forest areas. Thus, these instruments are likely to constrain forests capacity for habitat provision, nutrient cycling, and moderation of extreme events (Framstad et al., 2022; Helseth et al., 2022). Although subsidies for *silviculture* promote capacity for timber, incentives for increased timber harvest (such as forest roads) may reduce timber capacity in the short-term. Moreover, intensive forestry may both promote and constrain capacity for food production, recreation, and carbon sequestration, as described in 4.2.1. (see e.g., Helseth et al., 2022). Through incentivizing denser planting and fertilization, subsidies and tax reliefs targeting *carbon sequestration* promote capacity for timber. However, nitrogen fertilizing is likely to have

negative effects on capacity for nutrient cycling and habitat provision (Austnes et al., 2018; Aarrestad et al., 2013). Moreover, as these subsides primarily promote a densely managed forest, they tend to constrain recreation, sense of place, and food production (Helseth et al., 2022; Magnussen et al., 2020). Lastly, subsidies and tax reliefs for environmental considerations promote habitat provisioning and nutrient cycling, whereas they may constrain capacity for timber production (e.g., in terms of rendering areas unavailable for forestry due to environmental consideration) (Tomter & Dalen, 2018).

4.2.4. PES-like schemes

This PES-like scheme promotes capacity for habitat provisioning, nutrient cycling, and also for recreation (Barton et al., 2013; Frivillig Vern, 2022; Norsk Friluftsliv, 2020). Although capacity for moderation of extreme events is promoted through forest cover reducing the risk of landslides etc., the risk of forest fires may increase in protected forest areas (see e.g., Helseth et al., 2022). Moreover, timber production is constrained, as the conserved forest area is made inaccessible for timber harvest, and not managed with the aim of achieving high quality timber (Frivillig Vern, 2022; Tomter & Dalen, 2018).

5. Conclusion

Through using investment volumes embedded in economic instruments as a proxy for the importance attributed to different forest ecosystem services, we examined the relationship between these instruments and the status and trends of forest ecosystem services. Specifically, we i) mapped the most important economic instruments in Norwegian forest governance, targeted ecosystem services and associated scales of investments, and ii) examined how existing economic instruments promote or constrain forests capacity to supply different ecosystem services.

The most prominent economic instruments in Norwegian forest governance include i) markets for provisioning and cultural ecosystem services, ii) forest certification schemes through PEFC and FSC, iii) subsidies and tax reliefs, and iv) payments for forest conservation. Markets for timber (578 mill €/y) and hunting licenses (74.1 mill €/y) amount to gross revenues of around 652.1 euros per year. Moreover, subsidies, tax reliefs, and PES-schemes primarily target habitat provision (43.68 mill €/y), timber (38.17 mill €/y), and carbon sequestration (2.53 mill €/y). We did not find any *taxes* targeting the recovery of declining ecosystem services. Nor did we find economic instruments targeting the cultural service *sense of place*, or the regulating services *moderation of extreme events* or *nutrient cycling*.

The results indicate an underinvestment in ecosystem service diversity in Norwegian forests. Except for payments for forest conservation (habitat provision), the government expenditures promote ecosystem services with already increasing trends in capacity (timber and carbon sequestration). Unregulated timber markets provide major pushes in favor or provisioning services, while government expenditures largely promote industrialized forestry (with clear-felling) and increased infrastructure development in forest areas. Overall, we find that the instruments that promote timber and carbon sequestration tend to constrain regulating and supporting services. Thus, economic instruments of Norwegian forest governance contribute to sustaining trends that favor provisioning services at the expense of supporting, regulating, and cultural services. Our results suggest that major reallocation of investments and expenditures will be required to increase capacity

for ecosystem services with declining trends, such as habitat provision and moderation of extreme events.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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APPENDIX

Table A.1: Indicators for measurement of capacity for forest ecosystem services, level of uncertainty in data and information, adapted from Helseth et al. (2022)

Ecosystem service type	Ecosystem service subtype	Description	Indicator for measurement of capacity	Level of uncertainty
Provisioning services – physical goods obtained from nature				
Raw materials		Energy and materials from forest for direct use or processing	Area covered by forest (km²) Productive forest area (km²)	+
	Timber	Harvesting of timber for sale or industrial production	Timber standing volume (m³)	+
	Bioenergy	Production of bioenergy by TWh	Timber standing volume (m³)	++
Food production		Food production from forest (animal farming, game meat, or other wild foods)	Area and quality of types of forest relevant as grazing areas, hunting, or harvesting of wild berries	++
	Livestock grazing	Milk or meat generated from livestock grazing in forest areas (e.g., sheep, goats, and cows)	Number of "fodder units" accessible for livestock fodder in outfield pastures Assessment of the condition of the nature type of "grazing forest".	++
	Game meat	Game meat from hunting of wild ungulates	Population numbers of most hunted species of wild ungulates	+
	Wild foods	Wild foods like berries, plants, and mushroom	Descriptions of accessible forest areas (nature types) where harvesting of wild foods is possible	+++
Cultural services - Immaterial benefits obtained from interaction with nature				
Outdoor recreation and tourism		Use of forest areas for recreational purposes	Available and accessible forest areas with attractive qualities for recreation	++
	Hiking	Recreational activity of hiking in forest areas	Accessible forest areas, e.g., through enabling infrastructure	++
	Hunting	Recreational activity of hunting in forest areas	Population numbers of most hunted species of wild ungulates Accessible forest areas for hunting	+
	Harvesting wild foods	Recreational activity of harvesting wild foods	Descriptions of accessible forest areas (nature types) where harvesting of wild foods is possible	+++
	Tourism	Commercial elements of forest-based activities	Available forest areas with good qualities for hunting, fishing, or outdoor recreation	++
 Sense of place and community		Contribution to identity, sense of belonging and social cohesion.	Available forest for harvesting of raw materials and food production Available and accessible forest areas with attractive qualities for recreation	+++
Regulating services - Benefits humans derive from ecological regulation processes				
 Carbon sequestration and storage		Carbon sequestration and storage in forest ecosystems	Area covered by forest (km²) Timber standing volume (m³)	++
 Nutrient cycling		Storage or flow of nitrogen (N), phosphorus (P) and base cations (Ca, Mg, K etc.)	The size and balance of nutrient pools maintained through natural ecological processes	+++
 Moderation of extreme events		Forest's contribution to fixing soil and moderating extreme events	Resilient forest covers in areas that are vulnerable to erosion, landslides, and other damages as result of extreme weather events.	+++
Supportive/ habitat services - Provision of habitat for species along their life cycle				
 Habitat provision		Provision of habitat for forest dependent species	Share (percent) of natural forest, not previously clear-cut Share (percent) of forest older than 160 years Share (percent) of wilderness-like area The condition of forest ecosystems indicated by the Norwegian Nature Index and the assessment of ecological condition	++

Table A.1.: *Source Helseth et al. (2022). Own elaboration with icons by Jan Sasse for TEEB (except for icons 'outdoor recreation' and 'sense of place and community'). + indicates level of uncertainty in data and information, where + = low; ++ = medium, and +++ = high level of uncertainty.*

Article 3

Helseth, E. V., Vedeld, P., Vatn, A., & Gómez-Baggethun, E. (2023). *Value asymmetries in Norwegian forest governance: The role of institutions and power dynamics.* Submitted to Ecological Economics on 3 March 2023. Revised version resubmitted on 14 June 2023.

Value asymmetries in Norwegian forest governance: The role of institutions and power dynamics

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Abstract

We draw on institutional and ecological economics to understand the role of social preferences, institutional arrangements, and power dynamics in mobilizing or restraining ecosystem services and values in Norwegian forest governance. Specifically, we i) elicit local people's preferences over forest ecosystem services and values, ii) analyze how perceptions of forest values vary across stakeholders, and iii) examine how participation is enabled by institutional arrangements. Our data were collected from a survey (N = 1694) distributed in 10 rural municipalities and from interviews with Norwegian forest experts and stakeholders (N = 15). Four results are highlighted. First, most respondents rank ecosystem services that embody relational and intrinsic values (such as recreation and biodiversity) higher than services that primarily embody instrumental values (timber). Second, women and non-forest owners show higher appreciation for relational values than men and forest owners. Third, dominant value-articulating institutions, such as timber markets and cost-benefit analysis, favor utility, efficiency, and instrumental values. Finally, few participatory arenas for decision-making are available, and local people do not feel empowered in forest governance. Our findings indicate that Norwegian forest governance primarily empowers actors that emphasize instrumental values followed by those who emphasize intrinsic values, whereas relational values tend to be restrained.

Key words: forest governance, value pluralism, value-articulating institutions, human-forest relationships, Norway.

The kind of values that are dominant in society is determined by power relations, for example because economic and political interests determine which values - and whose values - have most traction in decision-making. Mobilizing alternative and more diverse values therefore involves changing power relations, empowering those whose values have been rendered less visible (…). (Martin et al., 2022:4).

1. Introduction

Forests provide multiple ecosystem services, including raw materials, food, recreation, sense of place, carbon sequestration, and habitats for biodiversity (Brockerhoff et al., 2017; Jenkins & Schaap, 2018). One fourth of all valuation studies globally address forests (IPBES, 2022a), and policy initiatives such as the Sustainable Development Goals (SDGs), the Convention on Biological Diversity, and the EU forestry strategy 2030 (European Comission, 2021) put forests and forest's benefits at center-stage in international sustainability agendas.

Environmental science and policy increasingly emphasize assessment and decision-support frameworks that integrate plural values of nature (Jacobs et al., 2016; Pascual et al., 2017). Yet, the IPBES (2022a) assessment of nature's values found that decision-making processes remain primarily guided by a narrow set of market-oriented values. This finding resonates with growing interest in participatory processes for sustainable forest governance (see e.g., Kangas et al., 2010; Sandström et al., 2020; Sheppard & Meitner, 2005) and with ongoing discussions on the role of power and institutions (conventions, norms, and legal rules) in defining which values gain prominence over others in scientific and political agendas (Martin et al., 2022; Martinez-Alier, 2003; Vatn, 2005).

This research draws on theory from ecological economics and institutional theory to understand the role of social preferences, institutional arrangements, and power dynamics in mobilizing or restraining specific ecosystem services and values in forest governance. Key terms guiding our analysis include environmental governance, value incommensurability, and value-articulating institutions. *Environmental governance* refers to the "use, management and protection of environmental resources and processes" (Vatn, 2015:134), which typically involves conflicts regarding who should get access to resources, whose interests are prioritized, and how nature should be valued (ibid).

Incommensurability of values entails the idea that nature bears diverse values that cannot be compressed into a single metric or measurement rod (Gómez-Baggethun & Martín-López, 2015; Martinez-Alier et al., 1998; Martinez-Alier, 2003). The idea of incommensurability is thus tightly connected with the recognition of plural values that are irreducible to each other. Decision-support frameworks that acknowledge value incommensurability, such as multi-criteria valuation, have been long used in ecological economics (Martinez-Alier et al., 1998; O'Neill & Spash, 2000; O'Neill et al., 2008), and have received renewed attention in the extensive literature on integrated valuation of ecosystem services over the last decade (Dendoncker et al., 2013; Gómez-Baggethun et al., 2014; Langemeyer et al., 2018; Saarikoski et al., 2016).

Through a distinction between worldviews, broad values, and specific values, the IPBES values assessment (2022b) expands on the concept of value pluralism. It defines *worldviews* as "mental lenses through which humans social groups perceive, think about, interpret, inhabit and modify the world. Rooted in *cultural traditions*, they shape and are shaped by *knowledge systems*, *languages*

and *values*" (IPBES, 2022a:546; italics in the original). *Broad values* are defined as the: "life goals, general guiding principles and orientations towards the world that are informed by people's beliefs and worldviews (Dietz et al., 2005)" (IPBES, 2022a:545). Broad values include both *moral principles* (such as justice), and *life goals* (such as prosperity), and they underpin *specific values* of nature, defined as "(…) judgments regarding the importance of nature in particular situations." (IPBES, 2022b:10). Specific values are classified in three main categories: instrumental, intrinsic, and relational values. *Instrumental values* refer to values that: "relate to things that are a means to a desired end (...)" (ibid.), while *intrinsic values*: "relate to the values of nature expressed independently of any reference to people as valuers (...)" (ibid.). Lastly, *relational values* refer to: "the meaningfulness of people-nature interactions, and interactions among people (including across generations) through nature (e.g., sense of place, spirituality, care, reciprocity)." (ibid.).

As opposed to primarily perceiving values and preferences as individual and given, classical institutional economics emphasizes that values are significantly shaped by societal and collective processes – implying that values are largely expressions of culture (Vatn, 2015). Moreover, power dynamics defining existing institutional arrangements play an important role in defining which values are perceived as legitimate and important in decision-making processes (ibid.). The role that institutional arrangements play in valuation processes can be analyzed through the concept of *value-articulating institutions* (VAI's) (see e.g., O'Neill & Spash, 2000), defined as "rule structures facilitating the articulation of values and interests" (Jacobs, 1997 cited in (Vatn, 2015:264). VAI's are "based on rules defining which values can be expressed and in what form" (Anderson, 2022:61). These rules are embedded in evaluation methods and decision support frameworks, such as cost-benefit analyses, multicriteria analysis, or deliberative valuation. In this way, VAI's act as frames invoked in the process of expressing values that regulate and shape which values come forward, which are excluded, and what sort of conclusions and policy recommendations can be reached (Vatn, 2005).

This paper draws on the case of Norwegian forest governance to examine people's values and preferences of forest ecosystem services, and to analyze how institutions mobilize or restrain different forest values, and how different actors are correspondingly empowered or disempowered in forest governance. To this end, the paper pursues the following objectives: i) to examine which forest ecosystem services are considered most important by local communities in Norwegian rural areas, ii) to assess how appreciations of different services and values relate to specific socio-demographic characteristics, iii) to examine which value-articulating institutions dominate Norwegian forest governance, and iv) to discuss the ways in which these value-articulating institutions support or undermine the values and interests of different socio-demographic groups.

2. Forest governance in Norway

Forests cover one third (37%) of Norway's land area and have historically been critical for livelihoods throughout the country (Bækkelund, 2020; Hoen et al., 2019; Tomter & Dalen, 2018). As much as 77% of the productive forest areas are today privately owned, partly due to historical processes of privatization and enclosure dating back to the 1600s (Gangdal, 2011) and accelerated in the 1800s (Skogen, 2018). Most of the forest properties are owned by *smallholders*; 60% are smaller than 25 ha, and 90% are smaller than 100 ha (Statskog, 2015).

While a state-driven shift from selective cutting to even-aged stand management (i.e., clear-cutting and planting of monocultures) has tripled forest biomass since around 1920, employment in forestry fell from around 28 500 in 1950 to 6 600 in 2018 following mechanization and tertiarization of the economy (SSB, 2021b; Tomter & Dalen, 2018). Although forests are still important sources of revenue for some communities, the primary role of forests has gradually shifted from livelihoods to recreation, home for biodiversity, and carbon sinks (Helseth et al., 2022; Hoen et al., 2019). Yet, the ecological condition of Norwegian forests is relatively poor[1], mainly due to intensive even-aged forest management and infrastructure developments in forest areas (Framstad et al., 2022).

Key legislations affecting Norwegian forest governance include the Forestry Act, the Outdoor Recreation Act, the Nature Diversity Act, and the Planning and Building Act (Tomter & Dalen, 2018). While the Planning and Building Act guide municipal planning (with requirements for public participation) (Lovdata, 2008), the introduction of the Nature Diversity Act in 2009 brought increased attention to issues regarding biodiversity (Lovdata, 2006; Lovdata, 2009). However, recent critics hold that the decision-making processes related to forestry (such as building of forest roads), are primarily guided by the Forestry Act, with minor public involvement (see e.g., Altinget, 2023).

Moreover, reports showing that Norwegian forest governance favor provisioning ecosystem services at the expense of supporting, regulating, and cultural services, suggests that broader deliberation over forest values is required to inform national sustainability agendas (see e.g., Aspøy & Helseth, 2022; Aspøy & Stokland, 2022; Bartlett et al., 2020; Helseth et al., 2022; Lindhjem & Magnussen, 2012; Nesbakken, 2022). This also connects to calls for improved knowledge on how diverse values and preferences are reflected and mobilized in different European forest governance regimes (Lindahl et al., 2017a; Lindahl et al., 2017b; Primmer et al., 2021; Sandström et al., 2020).

[1] The ecological condition of Norwegian forests is classified with the value of 0.42, against a "good condition" of 0.6, and with an optimal/ maximum score of 1.

3. Framework and methods

Data for this research were drawn from three main sources: i) a literature review, ii) in-depth interviews with forest experts and stakeholders (N = 15), and iii) a survey (N = 1694) distributed among local inhabitants in 10 rural municipalities in Norway (Fig 2).

3.1. Literature review

To get an overview of ecosystem services, values, and institutions in Norwegian forest governance, we reviewed policy documents, scientific papers and reports, books, media articles, and grey literature. Our primary focus was to i) identify main VAI's guiding decisions affecting forestry practices and infrastructure development in forest areas, and ii) assess each VAI following the criteria described in section 3.3. Results from the initial literature review were used to inform the framing of the survey (see 3.2.) as well as the design of the interview guide (see 3.3).

3.2. Survey

We designed a digital survey in cooperation with the Norwegian Centre of Competence on Rural Development and the relevant municipalities[2]. The survey had multipurpose aims of producing knowledge for policy development nationally and locally (see e.g., Skavhaug et al., 2022). It was tested with a national reference group (N = 11) before it was revised and distributed among inhabitants of Hyllestad, Fjaler, Askvoll, Solund, Bykle, Vang, Grue, Sør-Aurdal, Engerdal and Rendalen municipalities from November 2021 to April 2022 (Figure 1). These 10 municipalities were selected to represent a mix of forest areas and nature types.

Solund, Vang, Bykle, and Askvoll are typical coastal or mountain areas, with relatively low forest cover (see Table 1). Fjaler and Hyllestad are relatively small costal municipalities, but with larger shares of forests than the former mentioned. Grue, Sør-Aurdal, Engerdal, and Rendalen all have vast forest areas, in which forest is important for local livelihood and culture, although Engerdal has less active forestry (SSB, 2023b). Based on the level of active forestry over the last 10 years, we grouped the municipalities as either 'forestry communities' (Grue, Rendalen, and Sør-Aurdal) or 'communities with less active forestry' (Solund, Vang, Bykle, Askvoll, Hyllestad, Fjaler, and Engerdal) (Figure 2).

[2] Norwegian municipalities are local governmental bodies with a political level (city council) and an administrative level. Both levels were represented in developing the survey.

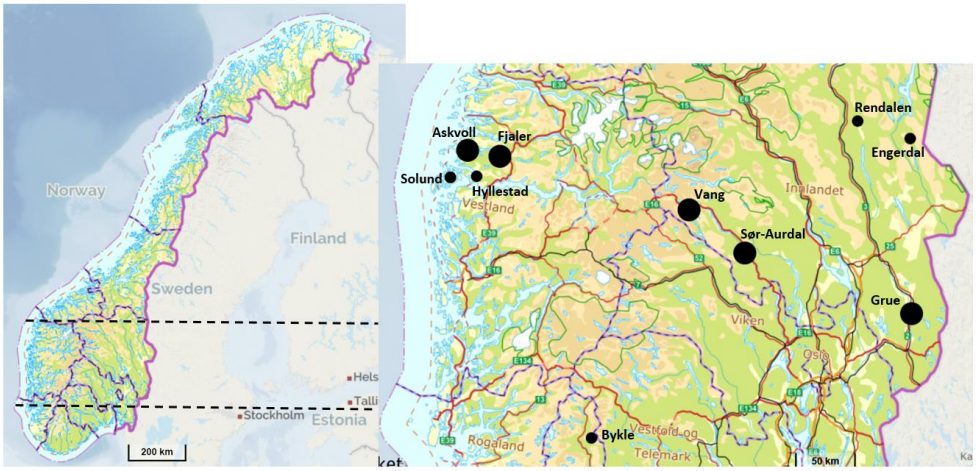

Fig 1: Municipalities sampled in the survey, Southern Norway, 2021-2022, Source (©norgeskart.no, 2022). Circle size indicates sample size as small (n< = 130) or large (n> = 130).

Table 1. Overview of population and share of forest area in each municipality

		Forest, percent of unbuilt land area	Forest, km^2 of unbuilt land area	Total km^2 of unbuilt land area	Population in 2022
Communities with less active forestry	Solund	7.6%	17.14	225.22	768
	Vang	12.3%	184.45	1495.45	1310
	Bykle	17.2%	250.48	1456.89	935
	Askvoll	22%	70.64	320.51	2951
	Fjaler	48%	197.22	409.87	2901
	Engerdal	48%	1 048.23	2184.56	1253
	Hyllestad	53%	134.55	253.86	1290
Forestry communities	Rendalen	54.9%	1734.75	3160.54	1722
	Sør-Aurdal	71.4%	777.86	1089.01	2889
	Grue	80.5%	658.59	817.86	4548

Source: (SSB, 2023a). Solund and Bykle are two of the least populated municipalities in Norway. The low percentage of forest is due to these communities being an island community in the far west of Norway (Solund) and a mountain community (Bykle).

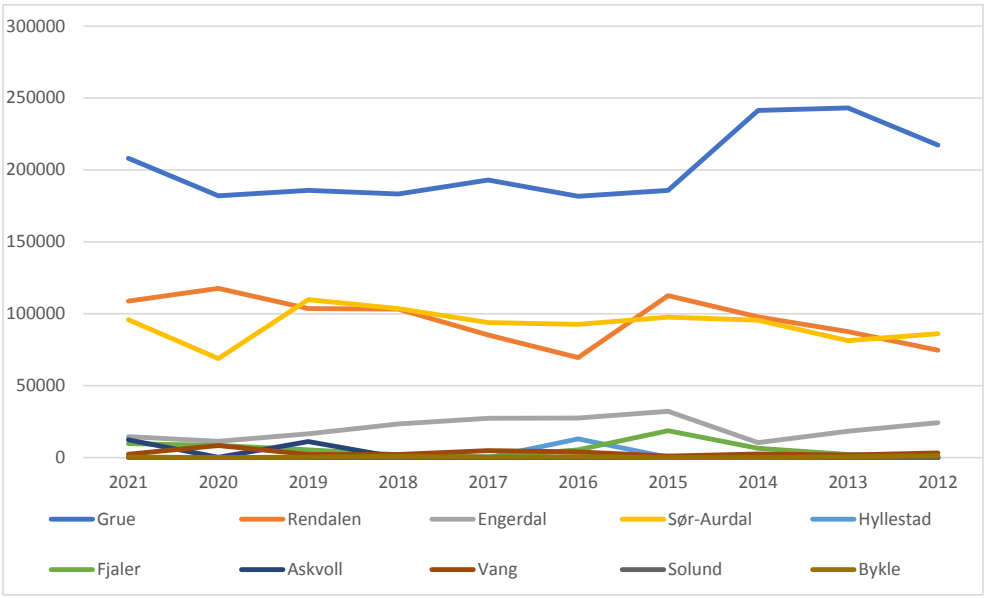

Figure 2. Overview of timber harvested for sale (m^3) in the different municipalities, 2012-2021. The tree species harvested are primarily spruce, followed by pine, and occasionally also some deciduous trees (typically birch) (SSB, 2023b).

The survey consisted of two main parts. The first section contained closed questions covering issues of social, environmental, and economic sustainability, both relating to the local community and to national/ international issues (see questions in Table A.1. in Appendix). Second, the survey also covered closed questions about forest values and ecosystem services (see 3.2.1). Socio-demographic variables collected for our case study include i) age, ii) gender, iii) level of education, iv) level of income, and v) forest ownership (including size of forest area).

The survey was distributed online via the municipal administrations, and it was spread through different channels, including the municipalities' websites, social media, local organizations, and/ or local newspapers. The survey stayed open for approximately 1 ½ month in each municipality, and participation was anonymous. The survey was open to all inhabitants, and thus based on self-selection (not on a randomized sample). This may entail a representation bias towards specific groups, such as people with particular interest in issues of local community development, or with more time available. To encourage diverse participation, the survey was framed as a broad inquiry of inhabitants' views on local development, in which all local voices mattered. We monitored responses, and were we noticed low participation from certain groups (e.g., those aged below 35), the municipality was notified, and then made extra efforts to reach these groups.

3.2.1. Perceived importance of forest ecosystem services

After posing the question: "In which way is the forest in the municipality most important to you and your local community?", we asked respondents to grade (from 1 to 5) the importance of 9 specified forest ecosystem services. These services were chosen based on previous research identifying the most important ecosystem services from Norwegian forests (Berglihn & Gómez-Baggethun, 2021; Helseth et al., 2022; Lindhjem & Magnussen, 2012). The dual formulation of the question was

intended to make respondents reflect on the importance of forests both in terms of individual preferences and community values, as respondents tend to display different values when asked in individual (e.g., as consumers) vs. collective contexts (e.g., as citizens) (Sagoff, 1998). We also included the (optional) open question: *«do you have other thoughts on the importance on forest for you and your local community?"*[3]

For data analysis, we classified forest ecosystem services according to established international categorizations of supporting, cultural, provisioning, and regulating services (MEA, 2005; TEEB, 2010) (Table 2). Further, we followed the IPBES (2022a) classification of instrumental, intrinsic, or relational values to identify which values are most prominent in each ecosystem service (see also Arias-Arévalo et al., 2017). Some services may embody multiple values (see e.g., Arias-Arévalo et al., 2017; Gómez-Baggethun et al., 2016). As an example, hunting and harvesting of berries provide food (instrumental), but are important sources of relational values for significant shares of the population. In 2021, 7.6 % of Norwegians above 16 years old reported to have been hunting, while 41.6% had been harvesting berries and mushrooms (SSB, 2021a). Although harvesting timber[4] may also embody relational values for some users, harvest is currently done mostly by machines, with few people involved (SSB, 2015), undermining the significance of relational aspects if compared to e.g., hunting. Moreover, people may seek recreation and aesthetical experiences from forests primarily to gain pleasure (instrumental values), while closeness to forest may also be important elements of people's identity and social cohesion (relational values) (Chan et al., 2016).

Table 2: Categorization of forest ecosystem services in the survey

Type of forest ecosystem service	Ecosystem service category	Specific values
Biodiversity: Home for animals and biodiversity	Supporting	Intrinsic
Inspiration: Inspiration for arts, culture, and literature	Cultural	Relational
Spirituality: Spiritual values	Cultural	Relational
Aesthetical: Aesthetical (the landscape brings joy)	Cultural	Relational (instrumental)
Recreation: Outdoor recreation	Cultural	Relational (instrumental)
Harvesting: Harvesting of berries, mushrooms, and wild plants	Provisioning (cultural)	Instrumental (relational)
Hunting: Access to hunting and game resources	Provisioning (cultural)	Instrumental (relational)
Timber: Harvesting of timber	Provisioning	Instrumental
Carbon: Sequestration and storage of carbon	Regulating	Instrumental (intrinsic)

The secondary relation of each service to type of value is indicated in parenthesis

3.2.2. Statistical analysis

In total, 3076 local inhabitants answered the survey, fully or partially. We filtered out all respondents that did not complete the survey, which left a final sample size of 1694 respondents. We used the open-source statistics program Jasp for the statistical analysis, following three steps: i) retrieving

[3] The 175 written replies to this question indicated that respondents expressed their own opinion on forests importance for them and their community, as opposed to attempting to conduct some objective assessment.
[4] "Harvesting of timber" was perceived as distinct from harvesting of firewood – which many respondents mentioned as an additional important ecosystem services in their written replies.

descriptive statistics, ii) analysis of variance (ANOVA), and iii) an exploratory factor analysis to retrieve *broad values* which we used for examining correlations with *specific forest values*.

First, we retrieved descriptive statistics (with mean) on the appreciation of each of the 9 forest ecosystem services, as well as for the two statements: *"Forest in my municipality means a lot to me"* [importance] and "*I get to actively participate in decisions regarding forest in my municipality"* [participation].

Second, we conducted initial linear regressions of all socio-demographic variables related to each forest ecosystem service, and the two statements transcribed above. Gender and forest ownership stood out as two key determinants, and we used these variables for further analysis of variance. Gender has been found to be an important determinant for the value ascribed to ecosystem services (Calvet-Mir et al., 2016) and for public environmental concern (Liu et al., 2014), while private ownership is an important marker of institutional context (Vatn, 2015). We used Post Hoc Tests to confirm whether the identified differences were significant, and we retrieved mean, standard deviation, mean difference, and P-value (P-tukey). With regard to 'importance' and 'participation', we also examined variance between forest owners with different sized forest properties.

Third, we did an exploratory factor analysis across the general questions about social, environmental, and economic sustainability. From this analysis, we identified two factors[5] that reflected contrasting broad values. The first broad value was identified as perceiving economic and societal *progress as superior to nature responsibility*, while the second broad value entails seeing *responsibility towards nature* as a guiding principle (see Table A.2 in Appendix). Next, we retrieved Spearman's rho on correlations between holding one of these two broad values and appreciating specific forest ecosystem services.

3.3. Interviews and institutional analysis

We used the Environmental Governance Systems framework (Figure 3) (Vatn, 2015; 2021) as an analytical framework to identify and examine the most prominent actors, VAI's, and broad values of Norwegian forest governance.

Economic actors are defined here as those holding rights to productive resources, such as forestry owners or forestry operators, while *political actors* are those defining the resource regimes and the rules for the political process (such as ministries or municipalities). C*ivil society actors* are defined as those that offer legitimacy to political actors and formulate the normative basis of a society (Vatn, 2015:143). We make a distinction between *formal civil society actors* and the *citizen-side* of civil society. The former is comprised of organizations with formal structures (such as NGO's, mass media, university and research institutes, political parties, and organizations representing business). The latter represents the *general citizen* (e.g., all citizens in a municipality). There are significant overlaps between the different groups of actors. The same person can both be a political, economic, and a civil society actor – and all actors are indeed also citizens. The actor categories are thus 'roles', that can be useful for analytical purposes (Vatn, 2015).

[5] Both of these factors had internal reliability above 0.7 on Cronbach's a [α].

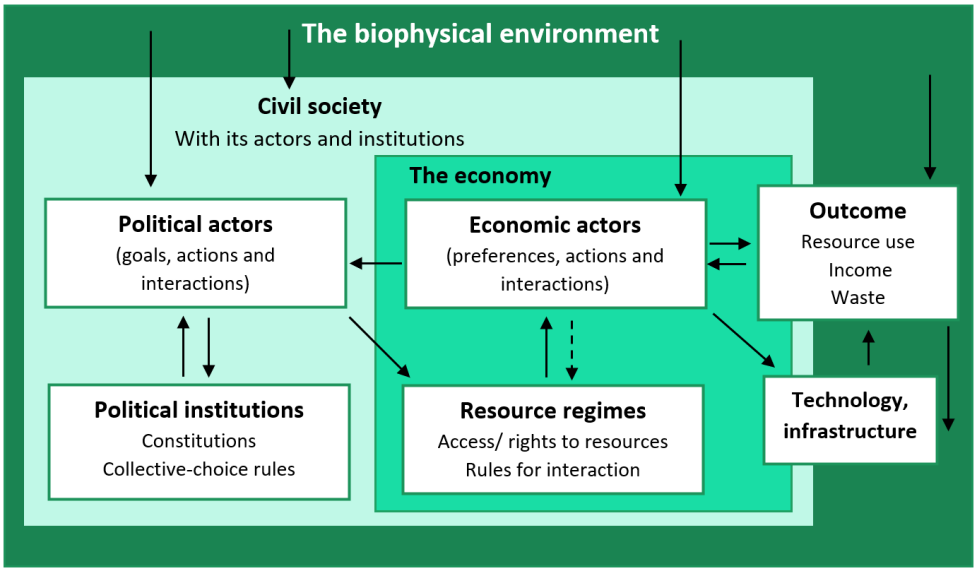

Figure 3: Integrated framework illustrating the interaction between ecological, political, and economic processes (Vatn, 2021)

We conducted thirteen interviews with *knowledge producers* working in research institutes or universities (formal civil society actors), and two field interviews with representatives from Oslo municipality and Sør-Aurdal municipality. Due to safety measures related to the Covid pandemic, most interviews were conducted digitally, except for the two field interviews. The interviews were in-depth and semi-structured and lasted 1 to 1 ½ hour each (see semi-structured interview guide in Appendix, Table A.3.).

We assessed the arrangements of each dominant value-articulating institution, following these criteria: i) who gets to *participate*, and in which capacity or actor-role (e.g., as consumers, citizens, stakeholder representatives, or experts)?, ii) how is the *process* defined (e.g., are participants expected to contribute as individuals or as a group, and are values seen as given, or as results of the specific process)?, iii) how are values expected to be expressed (e.g., as prices or as arguments, and is account taken for values that are incommensurable)?, and iv) which forms do *recommendations* and conclusion take; are they e.g., based on an aggregation of individually articulated values, or on a common consideration of arguments? (Vatn 2021:185).

4. Results

4.1. Survey results

Table A.4. in Appendix gives an overview of the number and proportion of respondents by different socio-demographic characteristics, while Table A.1. provides results for the general questions about social, environmental, and economic sustainability.

4.1.1. Importance of forest and forest ecosystem services

Respondents rank recreation (M = 4.325), biodiversity (M = 4.022), and aesthetics (M = 3.981) as the most important forest ecosystem services for themselves and their community (Table 3). The importance of forests for spirituality (M = 2.059) is ranked the lowest, followed by inspiration for arts, culture, and literature (M = 2.585), and harvesting of timber (M = 3.244). Next, although 70.8% of respondents deem that the forest in their municipality is important for them, only 11.2% consider that they get to participate actively in local governance.

Table 3. Appreciation of forest ecosystem services, and participation in forest governance, Southern Norway, 2021-2022

			Degree of perceived importance				
	Mean (M)	Std. dev. (SD)	Very important 1	2	3	4	Not important 5
Recreation	4.325	0.982	58.7%	23.4%	12.2%	3%	2.7%
Biodiversity	4.022	1.086	43.6%	28%	18.6%	6.4%	3.4%
Aesthetics	3.981	1.138	43.1%	27.5%	18.6%	5.8%	5%
Harvesting	3.792	1.148	34.2%	29.3%	22.7%	9%	4.8%
Hunting	3.773	1.303	39.6%	25.2%	17.7%	8%	9.5%
Carbon	3.559	1.239	29.8%	22.8%	29%	10.3%	8.1%
Timber	3.244	1.324	21.8%	21.6%	28.3%	13.9%	14.4%
Inspiration	2.585	1.276	9.5%	14.5%	27.2%	22.6%	26.2%
Spirituality	2.059	1.293	7.2%	8.9%	19%	16.1	48.8%

			Degree of agreement to statement				
	Mean	Std. dev.	Agree (1)	Agree some	Neutral	Disagree some	Disagree (5)
Importance	3.963	1.120	42%	28.8%	18.3%	5.5%	5.4%
Participation	2.419	1.146	4.3%	6.9%	45.9%	12.2%	30.7%

See 'importance' and 'participation' described in section 3.2.2.

Table A.5. in Appendix. provide an overview of appreciation of forest services in each municipality, while Table 4 shows differences across the two categories of communities. With the exception of hunting (no difference), all services are ranked significantly higher in the 'forestry communities'. The largest different is found in the appreciation of timber (MD = 0.732). However, the ranking of services remains mostly the same, except that in the forestry communities, aesthetics is ranked marginally higher than biodiversity, while carbon swop places with hunting.

Table 4. Appreciation of forest ecosystem services in 'forestry communities' and in 'communities with less active forestry', Southern Norway, 2021-2022

	Communities with less active forestry (N = 1136)		Forestry communities (N = 556)		Mean diff.	Significance
	Mean	Std. dev.	Mean	Std. dev.		P-value
Recreation	**4.235**	1.039	**4.509**	0.824	0.274	< 0.001***
Biodiversity	**3.955**	1.130	**4.158**	0.977	0.203	< 0.001***
Aesthetics	**3.887**	1.182	**4.173**	1.016	0.286	< 0.001***
Harvesting	**3.683**	1.196	**4.014**	1.008	0.332	< 0.001***
Hunting	3.781	1.277	3.757	1.356	0.042	0.722
Carbon	**3.458**	1.241	**3.766**	1.211	0.308	< 0.001***
Timber	**2.984**	1.278	**3.716**	1.281	0.732	< 0.001***
Inspiration	**2.443**	1.234	**2.876**	1.311	0.433	< 0.001***
Spirituality	**2.037**	1.265	**2.214**	1.334	0.177	< 0.008**
Important	**3.771**	1.196	**4.356**	0.918	0.585	< 0.001***
Participation	2.385	1.080	2.489	1.197	0.104	0.072

Overall, supporting and cultural services are ranked highest, while provisioning services that also include recreational aspects (such as harvesting and hunting) are ranked higher than services with a more distinct instrumental character (such as timber). These results are in line with reports showing that outdoor recreation is very important to Norwegians (MCE, 2016; MCE, 2018; NEA, 2020), and that material connections between forests and communities are waning (Helseth et al., 2022). The low ranking of inspiration for arts, culture, and literature may be related to this waning material connections, as Norwegian arts and literature emerging from human-forest relations have traditionally been closely connected to material uses of forests (Kaldal, 2022).

4.1.2. Differences across socio-demographic characteristics

Our results indicate that the appreciation of forest ecosystem services varies by the socio-demographic characteristics of forest ownership and gender (Table 5).

Table 5. Appreciation of forest ecosystem services by forest ownership and gender, Southern Norway, 2021-2022

	Women		Men		Mean diff.	Significance
	Mean	Std. dev.	Mean	Std. dev.		P-value
Recreation	**4.466**	0.922	**4.197**	1.023	0.249	< 0.001***
Biodiversity	**4.168**	1.014	**3.862**	1.135	0.306	< 0.001***
Aesthetics	**4.142**	1.076	**3.802**	1.176	0.340	< 0.001***
Harvesting	**4.003**	1.062	**3.553**	1.197	0.450	< 0.001***
Hunting	3.771	1.308	3.777	1.295	- 0.005	0.937
Carbon	**3.657**	1.199	**3.457**	1.271	0.199	< 0.001***
Timber	**3.156**	1.318	**3.299**	1.328	- 0.143	0.027*
Inspiration	**2.761**	1.273	**2.379**	1.247	0.382	< 0.001***
Spirituality	**2.256**	1.333	**1.904**	1.217	0.352	< 0.001***
Important	**4.016**	1.131	**3.913**	1.158	0.102	0.067***
Participation	**2.367**	1.067	**2.479**	1.178	- 0.112	0.041*
	Forest owner		Non-forest owner		Mean diff.	Significance
	Mean	Std. dev.	Mean	Std. dev.		P-value
Recreation	4.384	0.900	4.305	1.007	0.078	0.157
Biodiversity	**4.144**	1.011	**3.982**	1.107	0.162	0.008**
Aesthetics	3.947	1.134	3.991	1.140	- 0.044	0.492
Harvesting	**3.892**	1.107	**3.759**	1.160	0.133	0.040*
Hunting	**4.104**	1.142	**3.666**	1.334	0.437	< 0.001***
Carbon	3.638	1.205	3.533	1.249	0.105	0.135
Timber	**3.633**	1.249	**3.091**	1.321	0.542	< 0.001***
Inspiration	**2.475**	1.263	**2.621**	1.278	- 0.146	0.042*
Spirituality	**1.962**	1.255	**2.139**	1.303	- 0.177	0.015*
Importance	**4.153**	1.022	**3.901**	1.177	0.253	<0.001***
Participation	**2.847**	1.144	**2.280**	1.077	0.567	<0.001***

Gender: responses in categories 'Neither' (N = 3) and 'Do not want to say' (N = 11) were filtered out for the comparison across on gender, as numbers were too small for reasonable margin of error. Forest owners (N = 417), with 45.8% women (N = 191) and 54.2% men (N = 226).

First, women appreciate all forest ecosystem services significantly higher than men, except from timber and hunting. Specifically, women appreciate harvesting (MD = 0.450), inspiration (MD = 0.382), spirituality (MD = 0.352), aesthetics (MD = 0.340), biodiversity (MD = 0.306), recreation (MD = 0.249), and carbon (MD = 0.199), significantly higher than men. However, women have less appreciation for timber than men (MD = - 0.143), while there are no significant gender differences with regards to hunting.

Overall, these results indicate that men in the study areas have higher appreciation for instrumental values (embodied in the provisioning ecosystem services of timber), while women show higher appreciation for relational and intrinsic forest values (embodied in services such as inspiration and spirituality). These results are interesting in light of the traditionally strong male-dominance of Norwegian (and European) forest governance, in which female views and values have been

restrained (Follo et al., 2017; Kaldal, 2022). These results also align with previous research, e.g., showing that women emphasize different ecosystem services than men (Calvet-Mir et al., 2016), and that women mobilize intrinsic and relational values in forest governance (Agarwal, 2009).

Second, forest owners rank the importance of forests for timber (MD = 0.542), hunting (MD = 0.437), biodiversity (MD = 0.162), and harvesting (MD = 0.133) significantly higher than non-forest owners. Furthermore, forest owners rank spirituality (MD = - 0.177) and inspiration (MD = - 0.146), significantly lower than non-forest owners. These results indicate that forest owners overall hold higher appreciation for both provisioning and supporting services, and thus both for instrumental and intrinsic values. When controlling across gender, we found that the difference related to spirituality only appears between female non-forest owners (N = 706, M = 2.310) and female forest owners (N = 191, M = 2.021), with a mean difference of - 0.299. There is no significant difference observed between forest owners (N = 557, M = 1.901) and non-forest owners among males (N = 226, M = 1.921). This may indicate that the context of being a forest owner more strongly alters the relational values held and expressed by women.

Forests are also significantly more important to forest owners (MD = 0.253), and owners feel that they get to participate more actively in forest governance (MD = 0.567) than non-forest owners. Moreover, forest owners (M = 4.568) and non-forest owners (M = 4.266) in forestry communities consider forest significantly more important than forest owners (M = 3.893) and non-forest owners in communities with less active forestry (M = 3.741) (Table 6). The 'gap' between experienced participation in forest governance is larger between forest owners and non-forest owners in the forestry communities (MD = 0.792), than in the communities with less active forestry (MD = 0.501). Overall, non-forest owners in 'forestry communities' care very highly about forests (M = 4.277), but they do not feel empowered in forest governance (M = 2.285).

Table 6: Comparison of 'participation' and 'importance' amongst forest owners and non-forest owners in the two groups of communities, Southern Norway, 2021-2022

Forest owners

	Communities with less active forestry, (N = 272)		Forest communities, (N = 145)			
	Mean	Std. dev.	Mean	Std. dev	Mean diff.	Significance P-value
Importance	**3.926**	1.111	**4.579**	0.642	0.653	<0.001***
Participation	**2.728**	1.041	**3.069**	1.289	0.341	0.004**

Non-forest owners

	Communities with less active forestry, (N = 866)		Forest communities, (N = 411)			
	Mean	Std. dev.	Mean	Std. dev	Mean diff.	Significance P-value
Importance	**3.722**	1.218	**4.277**	0.986	0.556	<0.001***
Participation	**2.277**	1.070	**2.285**	1.093	0.008	0.907

Results also vary with the size of forest property (Table 7). As an example, those owning more than 200 ha of forests feel more empowered than those owning 0.5-10 ha (MD = 0.714).

Table 7. Size of property, importance of forests and degree of experienced participation, Southern Norway, 2021-22

	Importance				Participation			
	0.5-10 ha	**10-50 Ha**	**50-200 ha**	**200+ ha**	**0.5-10 ha**	**10-50 ha**	**50-200 ha**	**200+ ha**
Valid	69	123	133	92	69	123	133	92
Mean	3.957	4.057	4.150	4.435	2.449	2.870	2.812	3.163
Std. Deviation	1.104	0.986	1.026	0.953	1.008	1.040	1.129	1.303
P-value (ANOVA)			0.013**				0.001***	

4.1.3. Relationship between broad values and specific forest values

Perceiving economic and social *progress as superior to nature responsibility*, correlates negatively (Spearman's rho, Sr) with appreciation of most forest ecosystem services, except for hunting and timber, for which there is a positive correlation (Table A.6. in Appendix). The most significant negative correlation is found with carbon (Sr = - 0.281), biodiversity (Sr = - 0.271), inspiration (Sr = - 0.235), and spirituality (Sr = - 0.219). Holding broad values of responsibility towards nature, however, correlates significantly positive with most forest ecosystem services. The most significant positive correlations are with biodiversity (Sr = 0.429) and aesthetics (Sr = 0.403). Hunting has the weakest positive correlation (Sr = 0.105), while timber has no correlation.

These results indicate that broad values aligned with *nature responsibility* underpin intrinsic and relational values, while those that see *progress as superior to nature responsibility* favor instrumental values. We also found (Table 8) that women state higher levels of *responsibility towards nature* (MD = 0.291) and are less inclined to perceive economic and societal *progress as superior to nature responsibility* (MD = -0.234). These results align with previous research showing gender differences in environmental attitudes (Liu et al., 2014). Moreover, while forest owners rank services embodying instrumental values high, they score similar as average respondents on the two broad values. This may indicate that forest owners perceive governing forests for increased timber production as the most responsible way to care for forests.

Table 8. Broad values by gender and forest ownership, Southern Norway, 2021-2022

	Women		Men		Mean diff.	Significance
	Mean	Std. dev	Mean	Std.dev.		P-value
Progress superior to nature responsibility	**3.062**	0.822	**3.296**	0.920	-0.234	<0.001***
Responsibility towards nature	**4.183**	0.628	**3.892**	0.748	0.291	<0.001***
	Forest owner		Non-forest owner		Mean diff.	Significance
	Mean	Std. dev.	Mean	Std. dev.		P-value
Progress superior to nature responsibility	3.215	0.923	3.156	0.860	0.059	0.232
Responsibility towards nature	4.059	0.706	4.010	0.689	0.049	0.215

4.2. Institutional arrangements shaping forest values

We identified the main VAI's affecting decisions of Norwegian forest governance to be: i) timber-markets, ii) cost-benefit analysis, iii) forestry plans, and iv) municipal planning processes. We assessed each VAI following the criteria outlined in section 3.3. (see detailed results in Table A.8. in Appendix).

First, *timber-markets* have a long-standing dominance in shaping how values are articulated in Norwegian forest governance (Helseth et al., 2022). Timber prices are today defined by international timber markets, with few regulations (Tomter & Dalen, 2018). Such markets are dominated by broad values of utility and efficiency. Regarding specific values, instrumental values hold prominence. However, voluntary and market-based forestry certification schemes have been developed and implemented over the last decades, in dialog between forestry actors and civil society actors such as e.g., environmental NGO's (Tomter, 2023). The ability of the general citizen to shape forest values in timber markets is restricted to their role as consumers.

Second, *cost-benefit analysis* (CBA) inform larger state-led infrastructure development projects in forest areas, such as public roads or powerlines (NOU 1998:16; Sirnes, 2021). The aim of CBA is to inform decision aimed at maximizing overall net societal utility and secure efficient resource use. Through CBA, the values of different forest ecosystem services (such as timber, biodiversity, or recreation) are standardized (often in monetary terms) and compared to societal benefits or costs of infrastructure developments. Such analyses are typically done by experts. They may draw on surveys of e.g., willingness to pay (WTP) emphasizing people's consumer preferences and assuming commensurability of forest values which facilitate aggregation of data (Sirnes, 2021). Hence, beyond their role as consumers (expressions of WTP), CBA enables limited space for the general citizen to engage in and shape the values that currently dominate Norwegian forest governance.

Third, private forest owners are encouraged to develop a *forestry plan* that balance the long-term management of timber resources with environmental considerations. Guidelines for forestry plans are flexible (Lovdata, 2004), and the development of plans typically rely on inputs from forest owner companies and municipal administrations (Norges skogeierforbund, 2023). The main broad values dominating forestry plans are *utility* and *efficiency* in timber production, while negative effects on e.g., biodiversity and recreation are to be minimized. Instrumental values are mobilized, and the general citizen have no specified role in developing or approving private forestry plans (Lovdata, 2004).

Fourth, *municipal planning processes* regulate infrastructure development in forest areas, such as public roads, recreational homes, and urban development. Municipal planning is guided by procedural steps in the Planning and Building Act (PBA), which e.g., entails specific requirements for: i) impact assessments (IA), and ii) participation (Lovdata, 2008)[6]. *Impact assessments* are required for projects with significant effects on environment and society, and should e.g., include considerations of ecosystem services (Lovdata, 2017). IA's can mobilize intrinsic values through the use of biophysical indexes as independent valuation metrics, such as the Norwegian Nature Index (Certain et al., 2011; Jakobsson & Pedersen, 2020). However, besides recent mapping of important areas for

[6] However, infrastructure developments related to forestry (such as logging roads), are seen to be guided by the Forestry Act, which causes unclarity with regards to requirements for impact assessments and participation (Forskning.no, 2022).

recreation (NEA, 2014), there is a lack of formal data and indicators on cultural ecosystem services embodying relational values (Helseth et al., 2022). *Deliberative processes* (e.g., public meetings, open hearings) are required for some steps of municipal planning, but not on issues of forest governance, and there are no clear guidelines on how to equitably integrate plural values of forests (Lovdata, 2008). Furthermore, both IA and deliberative processes frame participation primarily towards those that are clearly defined stakeholders, as opposed to general citizens.

Our evaluation of the institutional arrangements affecting Norwegian forest governance, indicates that prevailing VAI's are expert-dominated, emphasizing instrumental values of forests (especially timber), or, to a less extent, intrinsic values (such as protecting biodiversity as an end in itself). We were not able to identify any presently used VAI's that clearly mobilize relational values of forests (such as recreation, place attachment, spirituality, and inspiration), or that empower actors emphasizing such values. Results also indicate that community involvement is rarely encouraged.

Overall, our results indicate that redesigning the VAI's guiding Norwegian forest governance is key to even out value asymmetries related to gender and ownership, and to mobilize plural values. This seems particularly important in 'forestry communities', where the gap between forest owners and non-forest owners perceived participation is largest. In particular, the role of PBA in issues of forest governance should be clarified and improved, with emphasis on multicriteria valuation and on inviting public participation through deliberative processes

5. Conclusion

We drew on theory from institutional and ecological economics to understand the role of social preferences, institutional arrangements, and power dynamics in defining which and whose values are mobilized or inhibited in Norwegian forest governance. Following our research questions, four main findings are highlighted.

First, most respondents rank ecosystem services that embody relational and intrinsic values (such as recreation and biodiversity) higher than services that primarily embody instrumental values (timber), and this ranking of services is similar across 'forestry communities' and communities with less active forestry. Second, women and non-forest owners show higher appreciation for relational values than men and forest owners. We also find that holding a broad value of "responsibility towards nature" underpin the appreciation of ecosystem services embedding intrinsic and relational values of forest, while perceiving progress as superior to nature responsibility corresponds with appreciating ecosystem services that embody instrumental forest values. Third, dominant value-articulating institutions, such as timber markets and cost-benefit analysis, favor utility, efficiency, and instrumental values. Finally, few participatory arenas for decision-making are available, and, except for those who own relatively large forest properties, local actors do not feel empowered in decision-making regarding forest ecosystems in their municipality.

Our results indicate that gender as well as property ownership and size are important markers of power in Norwegian forest governance. The existing governance regime empowers actors prioritizing instrumental values (especially forest owners), and, to a less extent, actors stewarding intrinsic values (e.g., environmental NGO's). The opportunity to express relational values associated with ecosystem services such as spirituality, inspiration, and aesthetics, are mostly restrained, and actors holding such values are largely disempowered. Balancing and diversifying nature's values may thus

involve empowering socio-demographic groups whose values have been left aside, with particular emphasis on women, smallholders, and non-forest owners. The large gap in perceived 'participation' between non-owners and owners in the forestry communities indicate that efforts to empower non-forest owners are particularly important in communities with active forestry.

Our analysis identifies possibilities to promote a broader array of forest ecosystem services and values through more inclusive forest governance approaches, less dominated by markets and experts enabling planning processes characterized by deliberation. This may require government actions to expand participatory power beyond forest owners, market actors, and NGOs, to engage the wider civil society in rural areas. This can be done through redesigning important value-articulating institutions with emphasis on promoting relational and intrinsic values, and through developing guidelines for multicriteria valuation. Specifically, the role of the Planning and Building Act in issues of forest governance should be clarified and strengthened, with emphasis on deliberative processes related to forest governance.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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APPENDIX

A.1. Results from closed survey questions on issues of social, environmental, and economic sustainability, Southern Norway, 2021-2022

	Mean (M)	Std. dev. (SD)	Disagree (1)	Disagree some	Neutral	Agree some	Agree (5)
I feel included and involved in the local community where I live	4.119	1.164	4.7%	7.1%	13%	22%	53.2%
The landscape and nature in the municipality mean a lot to my identity	4.441	0.890	2.1%	1.9%	9.1%	23.7%	63.2%
I am engaged in the development of the municipality	4.170	0.985	2.7%	3.8%	13.8%	33.2%	46.5%
I wish to live in the municipality in the future	4.311	1.089	3.2%	6%	11.3%	15.6%	63.9%
It doesn't matter much to me where I live, and I might as well live somewhere else	2.342	1.350	38.4%	22%	14.8%	16.5%	8.3%
I can be myself fully in my municipality	4.047	1.235	5.9%	9.4%	10.4%	22.7%	51.6%
We must focus on densification of the townships rather than scattered settlements	2.315	1.375	41.6%	18.2%	16.6%	14.3%	9.3%
If we do not get the population to grow, our local community will die out in the future	3.887	1.184	6%	9.6%	11.6%	35.3%	37.5%
Immigration from other countries is positive for the municipality	3.868	1.208	6.5%	7.7%	18.4%	27.3%	40.1%
There is too much talk about increasing the population, and those who already live here are forgotten	3.448	1.266	10.8%	13%	19%	34.9%	22.3%
Good health and quality of life should be a measure of social development, in the same way as GDP (gross domestic product)	4.433	0.784	0.7%	1.3%	10.2%	29.5%	58.3%
Social challenges are “drowned” in the focus on climate and environmental problems	3.646	1.198	8%	8.4%	22.3%	33.6%	27.7%
The municipality should purchase goods and services from local providers	4.504	0.793	1.1%	1.5%	7.7%	25.3%	64.4%
Climate change creates challenges in my local community	3.021	1.260	17.8%	13.3%	29.5%	27.8%	11.6%
There is an exaggerated focus on climate and the environment	2.973	1.445	23.5%	15.8%	20%	21.3%	19.4%

Sustainable development entails that we must be willing to change our way of life	3.700	1.182	7.5%	8.5%	18.9%	36.8%	28.3%
We must take better care of nature because it forms the basis of our lives	4.335	0.929	2.2%	2.7%	10.4%	28.6%	56.1%
Technological development will be able to solve most environmental challenges	2.744	1.113	16.5%	23.3%	34.4%	20.7%	5.1%
Nature has a value in itself, and we have an ethical responsibility to take good care of nature	4.548	0.772	1.1%	1.1%	7.7%	22.3%	67.8%
I feel that I get to influence the type of business and economic value creation we have in the municipality	2.551	1.144	25.7%	16.4%	39.2%	14.3%	4.3%
It is a problem that businesses in the municipality meets too many climate and environmental requirements	2.969	1.207	16.6%	13.3%	38.1%	20.7%	11.3%
We should better facilitate for new, green businesses	3.837	1.097	5.3%	4.4%	25%	32.2%	33.2%
The economic value creation should stay in the rural municipalities, where the natural resources are found	4.250	0.927	1.5%	1.7%	19.2%	25.3%	52.2%
The business community in my municipality is driving a more sustainable development	3.136	0.993	7.4%	11.5%	50.6%	20.9%	9.6%
Conservation of nature contributes positively to business developments and provides increased value creation	3.183	1.239	13%	12.8%	34.4%	22.4%	17.4%
Continued economic growth is a precondition for me to live with good quality of life	3.452	1.227	10.4%	9%	28.3%	29.6%	22.7%

Table A.2: Factors identified from survey statements

Economic and societal progress is superior to nature responsibility	**Responsibility towards nature as a guiding principle**
It is a problem that businesses in the municipality meets too many climate and environmental requirements	Nature has a value in itself, and we have an ethical responsibility to take good care of nature
Social challenges are "drowned" in the focus on climate and environmental problems	We must take better care of nature because it forms the basis of our lives
There is an exaggerated focus on climate and environmental issues	The landscape and nature in the municipality mean a lot to my identity
Continued economic growth is a precondition for me to live with good quality of life	Sustainable community development entails that we must be willing to change our way of life
REV_ Conservation of nature contributes positively to business developments and provides increased value creation	Conservation of nature contributes positively to business developments and provides increased value creation
Cronbach's a: 0.729	Cronbach's a: 0.732

Table A.1.: Both factors were tested for unidimensional reliability using Cronbach's a, for which above 0.7 was considered sufficiently reliable. The available responses to each of the statements were: disagree (1) – disagree some (2) – neutral (3) – agree some (4) – agree (5)

Table A.3: Semi-structure interview guide

Presentation of the research project (ECOREAL)

- The project's purpose and organization
- Underline the informant's rights
- Ask about future use of data

About the informant

- The informant introduces her/himself (background and current role)
- What does the forest mean to you?
- What is your role in [organization] and how long have you worked there?

The organization of the forest governance field

- What is the condition/state of Norwegian forest?
- What is the forest like as a political arena?
- Who works together and how does this take place?
- Whose opinions are heard?
- Which role does local communities play in forest governance today? (With *local communities* we e.g., think of a municipality, but perhaps primarily the general citizens of a municipality - do they have a role in forest management? Do you think role should be any different?)
- Do you feel that there is any discussion about the role of local communities/civil society in forest management?

Forestry

- How is the forest managed today?
- How should the forest be managed, and why?
- What are drivers and barriers for change?

The forest's contribution to sustainable community development

- What does the forest mean to Norwegian local communities? (Has the importance of the forest changed in the last 50 years? In what way?)
- What are the most important values that the forest contributes to our society? (Are these values recognized?)
- Do you have examples of cases that you believe illustrate well that different values from forests are safeguarded in decision-making processes? (Or the opposite; that different values from forests are not recognized or included in decision-making processes?)
- What comes to your mind when you hear the word “bioeconomy”? From your perspective, what is the forest's role in a possible bioeconomy? (Do we have to make some trade-offs, or may all aims for the forest be achieved?)

Other

- Did we forget something?
- Who else should we talk to?

Table A.4. Overview of respondents by different socio-demographic characteristics

Variable	Categories	Counts	Total	Porportion
Gender	Male	783	1694	0.462
	Female	897	1694	0.530
	Other	3	1694	0.002
	Do not want to say	11	1694	0.006
Age	13-15	67	1694	0.040
	16-19	37	1694	0.022
	20-24	50	1694	0.030
	25-34	224	1694	0.132
	35-49	507	1694	0.299
	50-66	613	1694	0.362
	67-75	151	1694	0.089
	76+	45	1694	0.027
Municipality	Bykle	72	1694	0.043
	Vang	319	1694	0.188
	Hyllestad	102	1694	0.060
	Askvoll	197	1694	0.116
	Fjaler	252	1694	0.149
	Solund	100	1694	0.059
	Grue	344	1694	0.203
	Engerdal	96	1694	0.057
	Sør-Aurdal	144	1694	0.085
	Rendalen	68	1694	0.040
Years lived in the municipality	Less than 1 year	38	1694	0.022
	1 - 2 years	51	1694	0.030
	3 - 4 years	65	1694	0.038
	5- 14 years	272	1694	0.161
	15 years or more	1268	1694	0.749
Owns forest	Yes	417	1694	0.752
	No	1263	1694	0.248
Highest level of education	Elementary school	56	1590	0.035
	Vocational school	164	1590	0.103
	High school	462	1590	0.291
	College/university up to 3 years	501	1590	0.315
	College university 3 years+	407	1590	0.256
Personal income (NOK/Y)	Up to 150 000	20	1590	0.013
	150 000 – 249 999	68	1590	0.043
	250 000 – 349 999	159	1590	0.100
	350 000 – 449 999	229	1590	0.144
	450 000 – 559 999	329	1590	0.207
	550 000 – 649 999	474	1590	0.298
	750 000 +	145	1590	0.091
	1 mill +	80	1590	0.050
	Do not know/ do not want to say	86	1590	0.054

Table A.4: proportion adds up to 100% within each category. Those in the age groups between 13-19 did not get questions about education and income.

Table A.5 Appreciation of different forest services by municipality

Home for animals and biodiversity

	Bykle	Vang	Hylle-stad	Askvoll	Fjaler	Solund	Grue	Enger-dal	Sør-Aurdal	Rendalen
Valid	72	319	102	197	252	100	344	96	144	68
Missing	0	0	0	0	0	0	0	0	0	0
Mean	**4.569**	**3.978**	**3.931**	**3.807**	**3.996**	**3.330**	**4.189**	**4.292**	**4.007**	**4.324**
Std. Deviation	0.784	1.161	1.110	1.103	1.095	1.288	0.976	0.857	1.054	0.762

Inspiration for arts, culture, literature

	Bykle	Vang	Hylle-stad	Askvoll	Fjaler	Solund	Grue	Enger-dal	Sør-Aurdal	Rendalen
Valid	72	319	102	197	252	100	344	96	144	68
Missing	0	0	0	0	0	0	0	0	0	0
Mean	**2.806**	**2.508**	**2.412**	**2.310**	**2.313**	**2.230**	**2.988**	**2.823**	**2.750**	**2.574**
Std. Deviation	1.380	1.308	1.146	1.139	1.221	1.171	1.316	1.114	1.260	1.342

Carbon sequestration and storage

	Bykle	Vang	Hylle-stad	Askvoll	Fjaler	Solund	Grue	Enger-dal	Sør-Aurdal	Rendalen
Valid	72	319	102	197	252	100	344	96	144	68
Missing	0	0	0	0	0	0	0	0	0	0
Mean	**3.625**	**3.483**	**3.314**	**3.406**	**3.651**	**2.920**	**3.776**	**3.563**	**3.701**	**3.853**
Std. Deviation	1.368	1.310	1.202	1.119	1.159	1.292	1.195	1.186	1.317	1.055

Harvesting berries, mushrooms ect.

	Bykle	Vang	Hylle-stad	Askvoll	Fjaler	Solund	Grue	Enger-dal	Sør-Aurdal	Rendalen
Valid	72	319	102	197	252	100	344	96	144	68
Missing	0	0	0	0	0	0	0	0	0	0
Mean	**4.153**	**3.749**	**3.549**	**3.467**	**3.683**	**3.150**	**4.023**	**4.250**	**3.924**	**4.162**
Std. Deviation	1.134	1.189	1.240	1.163	1.199	1.250	1.024	0.808	1.038	0.840

Hunting

	Bykle	Vang	Hylle-stad	Askvoll	Fjaler	Solund	Grue	Enger-dal	Sør-Aurdal	Rendalen
Valid	72	319	102	197	252	100	344	96	144	68
Missing	0	0	0	0	0	0	0	0	0	0
Mean	**3.917**	**4.060**	**3.804**	**3.589**	**3.702**	**2.950**	**3.750**	**4.198**	**3.583**	**4.162**
Std. Deviation	1.361	1.274	1.219	1.293	1.225	1.167	1.349	1.012	1.412	1.192

Spiritual values

	Bykle	Vang	Hylle-stad	Askvoll	Fjaler	Solund	Grue	Enger-dal	Sør-Aurdal	Rendalen
Valid	72	319	102	197	252	100	344	96	144	68
Missing	0	0	0	0	0	0	0	0	0	0
Mean	**2.194**	**2.113**	**2.029**	**1.919**	**1.944**	**1.940**	**2.369**	**2.260**	**2.063**	**1.750**
Std. Deviation	1.390	1.343	1.173	1.218	1.196	1.162	1.389	1.347	1.258	1.125

Harvesting of timber

	Bykle	Vang	Hylle-stad	Askvoll	Fjaler	Solund	Grue	Enger-dal	Sør-Aurdal	Rendalen
Valid	72	319	102	197	252	100	344	96	144	68
Missing	0	0	0	0	0	0	0	0	0	0
Mean	**2.306**	**3.009**	**2.922**	**2.964**	**3.242**	**2.520**	**3.602**	**3.323**	**3.889**	**3.926**
Std. Deviation	1.307	1.326	1.200	1.247	1.208	1.283	1.290	1.100	1.183	1.386

Recreation

	Bykle	Vang	Hylle-stad	Askvoll	Fjaler	Solund	Grue	Enger-dal	Sør-Aurdal	Rendalen
Valid	72	319	102	197	252	100	344	96	144	68
Missing	0	0	0	0	0	0	0	0	0	0
Mean	**4.750**	**4.245**	**4.265**	**4.157**	**4.278**	**3.440**	**4.512**	**4.656**	**4.417**	**4.691**
Std. Deviation	0.645	1.008	0.911	1.035	1.019	1.313	0.843	0.708	0.873	0.553

Aesthetical (the landscape brings joy)

	Bykle	Vang	Hylle-stad	Askvoll	Fjaler	Solund	Grue	Enger-dal	Sør-Aurdal	Rendalen
Valid	72	319	102	197	252	100	344	96	144	68
Missing	0	0	0	0	0	0	0	0	0	0
Mean	**4.514**	**3.931**	**3.824**	**3.721**	**3.948**	**3.090**	**4.209**	**4.344**	**4.014**	**4.324**
Std. Deviation	0.787	1.177	1.112	1.216	1.123	1.386	1.023	0.819	1.071	0.818

Table A.6. Correlations between appreciation of ecosystem services and factors

Variable		Progress superior	Nature responsibility
Nature responsibility		-0.598 ***	—
	p-value	< .001	—
Biodiversity	Spearman's rho	-0.271 ***	0.429 ***
	p-value	< .001	< .001
Inspiration	Spearman's rho	-0.235 ***	0.309 ***
	p-value	< .001	< .001
Carbon	Spearman's rho	-0.281 ***	0.381 ***
	p-value	< .001	< .001
Harvesting	Spearman's rho	-0.187 ***	0.369 ***
	p-value	< .001	< .001
Hunting	Spearman's rho	0.052 *	0.105 ***
	p-value	0.031	< .001
Spirituality	Spearman's rho	-0.219 ***	0.273 ***
	p-value	< .001	< .001
Timber	Spearman's rho	0.109 ***	0.019
	p-value	< .001	0.443
Recreation	Spearman's rho	-0.147 ***	0.383 ***
	p-value	< .001	< .001
Aestetical	Spearman's rho	-0.187 ***	0.403 ***
	p-value	< .001	< .001

Table A.7. Important value-articulating institutions (VAIs) for decisions regarding forestry and infrastructure developments in forest areas

Type of VAI	**Participants** (in which capacity)	Process	How to express values	Recommendation and decisions	Broad values	Specific values
Timber-markets	EA: forest owners, forest owners' organizations, entrepreneurs (timber producers) PA: ministries/ agencies (experts) CSA: knowledge producers, NGOs (experts or stakeholders) Cit: no participation	Individual participation. Few are involved. Values are seen as given	Monetary. Commensurability e.g., through forest certification.	Aggregation of individually articulated values. Decisions made by EA	Resource management, Utility, efficiency	Instrumental
Cost-benefit analysis	EA: developers (producers) PA: ministries/agencies, local governments (stakeholders or experts) CSA: NGOs and knowledge producers (experts) Cit: participation only as consumers (WTP)	Expert-led, individual participation. Few are involved. Values are seen as given	Monetary. Ecological indicators. Indicators on cultural uses (e.g., recreational mapping) may be used. Commensurability towards net societal utility	Aggregation of individually articulated values. Decisions made by PA	Resource management, Utility, efficiency	Instrumental
Forestry plans	EA: forest owners (timber producers) PA: municipal administration (experts) CSA: NGOs (stakeholders) Cit: no participation	Individual participation. Few are involved. Values are seen as given	Monetary. Ecological indicators. Indicators on cultural uses (e.g., recreational mapping) may be used	Aggregation of individually articulated values. Decisions made by EA	Resource management, Utility, efficiency	Instrumental
Impact assessments	EA: Forest owners (stakeholders) PA: municipal administration (experts) CSA: NGOs and knowledge producers (experts, stakeholders) Cit: participation (as stakeholders) in some processes	Expert-led, individual participation. Can involve few or be broad processes involving many people. Values are mostly seen as given	Monetary, ecological indicators. Indicators on cultural uses (e.g., recreational mapping) may be used. Few guidelines on integration of plural values	Aggregation of individually articulated values. May involve common consideration of arguments. Decisions made by PA	Resource management	Depends on process, most commonly instrumental
Deliberative processes in municipal planning	EA: stakeholders PA: municipal administration (experts) CSA: NGO's (stakeholders) Cit: participation in some processes	Both individual participation and as groups. Values can both be seen as given, and as result of processes	Few guidelines on integration of plural values	Common consideration of arguments – typically informed by aggregation of individually articulated values. Decisions by PA	Depends on process	Depends on process.

Table A.8. EA = economic actors, PA = political actors, CSA = formal civil society actors, Cit = general citizens. Important sources: Certain et al. (2011); Framstad et al. (2022); Jakobsson and Pedersen (2020); Lovdata (2004); Lovdata (2008); Lovdata (2017); Norges skogeierforbund (2023); Tomter and Dalen (2018); Tomter (2023)

Article 4

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Beyond green growth: Mapping sustainability pathways for rural transformations in Norway

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Abstract

Competing sustainability pathways, such as green growth and degrowth, reflect different values and preferred solutions in response to the climate and environmental crisis. The recent Values Assessment by Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) states that mobilizing a diversity of sustainability-aligned values (such as care and reciprocity) are key to sustainability transformations. This paper examines the role of values and livelihood options as leverage points for rural sustainability transformations. Drawing on IPBES's analytical framework, we assess support to four different sustainability pathways in rural Norway: i) green growth, ii) degrowth, iii) earth stewardship, and iv) nature protection. Data was collected from an analysis of fifteen policy documents (N=15) and a survey (N= 3591) distributed among local population in 12 Norwegian rural municipalities. Three main results are highlighted. First, green growth and associated values firmly dominate sustainability thinking in Norwegian policy agendas for rural development, followed by nature protection, and earth stewardship, while degrowth ideas are marginally represented. Second, while 17.5% of survey respondents describe profit or economic growth as key dimensions of sustainable development, one fourth (26.1%) emphasize nature protection, sufficiency, or local production. Finally, green growth supporters emphasize instrumental values and livelihood options based on tourism and industry, while degrowth supporters emphasize intrinsic and relational values through small-scale farming and resource use. Our results indicate that if Norwegian rural policy is to align with IPBES' recommendation to balance diverse values for sustainability transformations, policies should extend beyond green growth to incorporate a wider diversity of values, drawing on alternative sustainability pathways, such as nature protection, earth stewardship, and degrowth.

Key words: sustainability pathways, IPBES, rural livelihoods, transformative change, Norway

1. Introduction

The Intergovernmental Panel on Climate Change (IPCC) and the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services International (IPBES) have called for transformative changes in economic, political, and technological systems, alerting that gradual change approaches are no longer an option to achieve global sustainability targets (IPBES, 2022; IPCC, 2022). In specialized literatures, strategies for transformative change are increasingly referred to as *sustainability pathways*, defined by IPBES (2022) as "strateg[ies] for getting to a desired future based on a recognizable body of sustainability thinking and practice, driven by an identifiable coalition of researchers, practitioners, and advocates" (Martin et al., 2022:356). Acknowledging competing views on how to achieve sustainability, the recent IPBES Values Assessment report delineates four transformative pathways towards just and sustainable futures: green economy/ green growth[1], degrowth, earth stewardship, and nature protection.

These pathways emphasize different values and solution frameworks to the climate and environmental crisis. *Green growth* emphasizes technological innovation and instrumental values of nature; *degrowth* emphasizes egalitarianism, sufficiency, and local small-scale production; *nature protection* stresses ecocentrism, larger protected areas, and intrinsic values of nature, whereas *earth stewardship* emphasizes the role of local and indigenous people as custodians of nature, traditional knowledge, and relational values. Despite representing competing approaches, each of these pathways represent aspirations towards shared goals of sustainability and justice, and IPBES recommends mobilizing the broader diversity of values underlying these alternative pathways as leverage points for sustainability transformations (Martin et al., 2022; Pereira et al., 2020).

Like many communities across the world, rural municipalities in Norway are striving to implement the Sustainable Development Goals [SDG] (Lundberg et al., 2020; KS, 2021; Skavhaug et al., 2022). The SDGs promote economic growth (SDG8) (MLGM, 2021; MLGM & MFA, 2021; United Nations, 2022), and in a context of rural decline due e.g., to tertiarization, mechanization, and rural exodus (NOU 2020: 15, 2020; SSB, 2015; SSB, 2021), local governments are urged to promote green growth strategies, with emphasis on technological innovation, digitalization, and the promotion of renewable energy and sustainable tourism (MAF, 2016; MLGM, 2019a; NOU 2023: 3, 2023).

Despite sustained emphasis on growth, recent research shows that per capita ecological footprint, material footprint, land use change, and CO^2 emissions in Norway overshoot planetary boundaries (Fanning et al., 2021; O'Neill et al., 2018). Furthermore, green growth strategies based on large-scale development of renewables in rural areas, have come into friction with nature's values and indigenous livelihoods, leading to an intensification of environmental conflicts (Environmental Justice Atlas, 2023). A prominent example is the conflict that wind development promoted as part of the 'green shift' is causing among Sami communities living on reindeer herding (Skogvang, 2023). Another example is how intensive forestry (with clear-felling) promoted in the name of a sustainable bioeconomy undermines forest biodiversity and ecosystem services (see e.g., Framstad et al., 2022; Lindhjem & Magnussen, 2012; MAF, 2016; OECD, 2022).

[1] [1] Although the IPBES Values Assessment uses the term "green economy", the bulk of international research and policy associates "green economy" to "green growth" (see e.g., Hickel & Kallis, 2020; Stoknes & Rockström, 2018). This paper uses the term 'green growth', as it reflects a less vague and more clearly delineated set of sustainability values and policies.

In light of global calls for transformative changes towards sustainability (IPBES, 2019; IPBES, 2022; IPCC, 2022), the IPBES Values Assessment points to the dominance of short-term market-oriented values in decision-making as a major driver of global environmental decline (IPBES 2022). The report encourages policy-makers to plan and make decisions based on a broad diversity of values associated with different sustainability pathways (Martin et al., 2022). Drawing on the IPBES pathways typology (ibid., 2022), we examine how values and livelihood options associated with competing sustainability pathways are reflected in Norwegian rural policies and in people's sustainability conceptions. Our data is collected from a policy analysis and a survey distributed in 12 rural municipalities in Norway (N= 3591).

2. Background

2.1. Sustainability pathways

In the 1970s sustainability policies were strongly influenced by notions of limits to growth (Meadows et al., 1972). By contrast, in the 1980s, the Brundtland report (World Commission on Environment and Development [WCED], 'Our Common Future', 1987), framed growth as a central pre-requisite of sustainable development, deemphasizing limits to growth on the ground that they can be surmounted through technological and organizational developments (Gómez-Baggethun & Naredo, 2015). In the report's own words: "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. But technology and social organization can be both managed and improved to make way for a new era of economic growth" (WCED, 1987:24). The report further states that ''What is needed now is a new era of economic growth—growth that is forceful and at the same time socially and environmentally sustainable'' (WCED, 1987:14).

While green growth remains the dominant notion in global sustainability policy, the acceleration of environmental problems (IPBES, 2019; IPCC, 2022; MEA, 2005) and the failure of global sustainability policy to reverse environmental degradation, have prompted the return of environmental limits to the science and policy agendas e.g., under labels like *planetary boundaries* (Rockström et al., 2009; Steffen et al., 2015). Furthermore, whereas the SDG 8 promotes *economic growth* (United Nations, 2022), growing empirical evidence points to the connection between growth and escalating environmental problems, including climate change (Peters et al., 2011), resource depletion (Wiedmann et al., 2015), and biodiversity loss (IPBES, 2022; Otero et al., 2020). Furthermore, recent reviews of state of the art knowledge suggest that decoupling growth from environmental impacts is not happening anywhere near the pace and scale requite to meet global sustainability targets (Parrique et al., 2019), rising questions on whether green growth is a viable sustainability strategy (Hickel & Kallis, 2020).

In this context, science and policy initiatives are encouraging the exploration of sustainability pathways beyond the current fixation on growth (see e.g., the 'Beyond Growth' conference convened by the European Parliament, 2023; and the UN initiative 'Harmony With Nature', 2023). Specifically, the IPBES Values Assessment encourages mobilizing diverse values and sustainability pathways,

including green economy/green growth, but also alternative ones such as degrowth, earth stewardship, and nature protection (Martin et al., 2022).

Green growth is defined here as "an increase in economic output that lowers total environmental footprint" (Stoknes & Rockström, 2018:42). A green growth sustainability pathway rests on the assumption that absolute decoupling between economic growth and environmental impacts can be achieved through technological development and resource substitution. Drawing primarily on worldviews from neoclassical economic theory, green growth emphasizes ecoefficiency and instrumental values of nature, and underscores technological and organizational innovation as solutions to environmental problems (see e.g., Martin et al., 2022; Vatn, 2015).

Degrowth "emphasizes strategies that reduce the material throughput amongst wealthy societies, protecting human wellbeing through better distribution of material wealth rather than growth" (Martin et al., 2022:365). With roots in ecological economics and post-development thinking (Daly & Farley, 2011; Escobar, 2015; Georgescu-Roegen, 2011; Latouche, 2009), degrowth identifies material expansion driven by economic growth as a core driver of environmental degradation, and calls for governments to abolish or ignore GDP as a leading measure of economic progress (D'Alisa et al., 2014; Hickel, 2020; Kallis et al., 2020; Martin et al., 2022). Degrowth thus dismisses the trust in absolute decoupling (Hickel & Kallis, 2020; Parrique et al., 2019). Core values associated with degrowth include conviviality, sufficiency, and egalitarianism, as well as a focus on decentralized and localized production and consumption (D'Alisa et al., 2014).

Earth stewardship emphasizes relational values and solidarity, both between humans, and towards other-than-humans. With roots in sustainability science, political ecology, and agrarian studies, this pathway calls for: "the strengthening of local sovereignty, including agrarian reform (...) with a goal to promote biocultural flourishing" (Martin et al., 2022:356). *Earth stewardship* emphasizes the role of local communities and indigenous knowledge in nature's protection and sustainable use.

Finally, *nature protection* advocates ecocentrism and emphasizes intrinsic values of nature, stressing the need to protect all forms of life composing the biosphere (Martin et al., 2022). With roots in conservation science and deep ecology, the nature protection pathway calls for an expanded network of protected areas to ensure a future for all life on earth. A flagship policy associated with this pathway is e.g., the 'half-earth', which makes the case that half of the planet's surface should be protected to secure biodiversity protection (Wilson, 2016).

All these sustainability pathways have elements in common and represent alternative visions of just and sustainable futures, but they diverge in the values and livelihood options they promote. For example, advocates of *green growth* argue that growth is necessary for economic stability, prosperity, and job creation, and that environmental problems can be solved by decoupling economic growth from environmental impacts, whereas advocates of *degrowth* claim that the laws of physics make this link difficult to break, and that growth in gross domestic product (GDP) is no longer improving people's lives in wealthy nations (O'Neill, 2020). Likewise, whereas *nature protection* promotes wilderness and strives to minimize human inference on natural ecosystems, *earth stewardship* emphasizes the rights of local communities to access natural resources and their role as custodians of biodiversity and sustainable land use. The conflicts between pathways such as earth stewardship and nature protection, as outlined in the IPBES values assessment (Martin et al.,

2022), are prominent in rural areas, where protected areas restricting access to land and resources often result in conflicts with local and indigenous communities (Büscher et al., 2017; Gómez-Baggethun et al., 2013; Redpath et al., 2013). Conflicts are also apparent between green growth pathways promoting the escalation of renewables in rural and wilderness areas, and earth stewardship and nature protection pathways emphasizing traditional resource use and biodiversity protection (e.g., Skogvang, 2023). Martínez-Alier (2002) portrays such conflicts as 'valuation conflicts', i.e., as clashes around which and whose values are prioritized or sidelined in land use decisions.

2.2. Sustainability agendas in rural Norway

The Norwegian Rurality Index[2] categorizes 209 out of all 356 Norwegian municipalities as 'rural' (NOU 2020: 15, 2020). Rural municipalities, which host 14% of the population but cover 72% of the Norwegian land area, face challenges related to depopulation and changing livelihood compositions (MLGM, 2018; NOU 2020: 15). As the Norwegian population grew from 3.2 mill in 1950 to 5.5 mill in 2023, the share living in densely populated areas increased from 52% to around 80% (MLGM, 2018; SSB, 2023). Moreover, the share of working population employed by the primary sector declined from 50% in 1900 to 3% in 2020 (SSB, 2015; SSB, 2021). Productivity increases in agriculture has outcompeted most small-scale farms, pushing 80% of Norwegian farms out of production between 1949 to 2020[3] (SSB, 2021).

Since the mid-twentieth Century, the Norwegian government has developed various nature conservation schemes, and close to one fifth (17.6%) of the Norwegian land area is currently under some form of protection[4] (NEA, 2023). Ecosystems and biodiversity in rural Norway are under growing pressure from infrastructure development and intensive land-use practices (NOU 2013:10, 2013; OECD, 2022), and according to the Norwegian Nature Index, the ecological condition of key ecosystems such as forests and mountain areas is relatively poor (Framstad et al., 2022).

Pressure on nature and conflicts with traditional livelihoods are intensifying through the "green shift" (Burton et al., 2020; Flemsæter & Flø, 2021; Krøgli et al., 2020), a transition to a low carbon economy based on renewables and green growth. An illustration of this approach is the latest Energy Commission report from The Ministry of Petroleum and Energy's titled "More of everything – faster" (NOU 2023: 3, our translation). The Norwegian green shift strategy goes hand in hand with OECDs argument that agriculture is no longer the backbone of the rural economy and that there is a need for a "new rurality", with new economic engines (2006). Land use requirements for renewable energy in the green shift have led to an intensification of environmental conflicts with Sami communities living from traditional reindeer herding (Skogvang, 2023), local communities concerned with impacts on local landscapes (e.g., NRK, 2020), and organizations for the protection of nature (Naturvernforbundet, 2023) and outdoor recreation (DNT, 2023).

Although Norwegian municipalities are given significant responsibility for governing local nature and natural resources (MLGM, 2019:b; Groven & Aall, 2020; Lovdata, 2008), rural municipalities have

[2] Criteria for assessing degree of rurality include: i) centrality (40%), ii) population growth the last 10 years (40%), iii) growth of employment rate the last 10 years (10%), and iv) vulnerability of the local business composition (10%) (MLGRD, 2023).
[3] The number of active farms dropped from 213 400 to 38 600 between 1949 and 2020 (SSB, 2021).
[4] In total, 56 899 km^2 of the total land area is protected, either as national parks (55.5%), nature reserves (13.4%), landscape protection area (30.3%), or other (0.7%).

made limited progress to date in implementing the SDGs (Lundberg et al., 2020; Skavhaug et al., 2022). As rural communities strive to define their pathways to sustainability amidst rising value conflicts, there is a pressing need for improved knowledge about values and livelihood options associated with competing sustainability pathways.

3. Methods

Data for this research relied on two main sources. First, a policy analysis, including a review of influential policy documents guiding rural development policies in Norway and the municipal plans of the 12 rural municipalities. Second, a survey (N= 3591) distributed amongst local inhabitants of the same 12 rural municipalities (Figure 1).

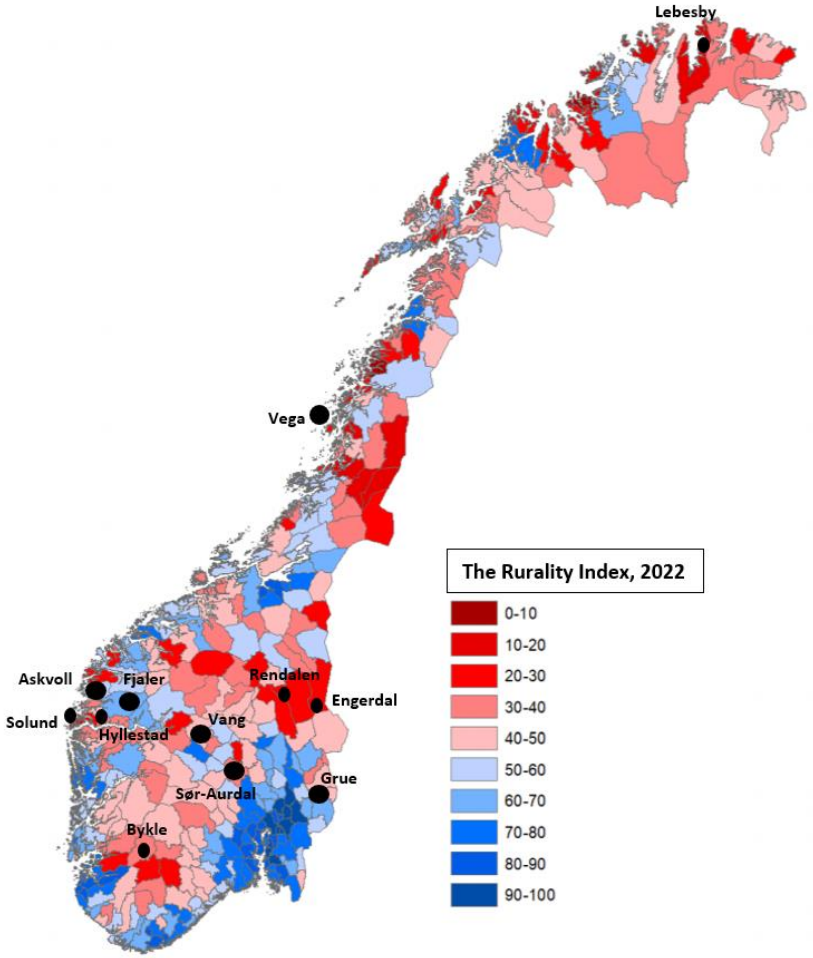


Fig 1: Geographical overview of the sampled municipalities in rural Norway, categorized by rurality (KMD, 2022). The degree of rurality of Norwegian municipalities is indicated from dark red (very rural) to dark blue (very urban). Sample size indicated as larger (big circle, N > =220), or smaller (small circle, N < = 220). Municipality (population number in 2022): Engerdal (1253), Rendalen (1722), Sør-Aurdal (2889), Grue (4548), Hyllestad (1290), Askvoll (2951), (Fjaler (2901), Vang (1310), Bykle (935), Solund (768), Vega (1223), and Lebesby (1341). The 12 municipalities host a population of 23 131 inhabitants.

3.1. Sustainability pathways in policy agendas

We followed a three-step approach to elicit whether and to which extent selected sustainability pathways feature in existing policy agendas for rural development.

First, we adapted IPBES' typology (Martin et al., 2022:406) to define four prominent sustainability pathways highlighted by the IPBES Valued Assessment report: i) green growth, ii) degrowth, iii) earth stewardship, and iv) nature protection. We characterized each sustainability pathway through indicators and descriptors derived from scientific publications and influential policy documents (see Table 1). Criteria that unite all pathways, demarcating them from a "no sustainability pathway", are that all of them acknowledge: i) a climate and environmental crises, ii) the need to respect planetary boundaries, iii) the importance of intergenerational justice, and iv) the need to integrate multiple values of nature in decision-making (Martin et al., 2022).

Second, to assess whether these sustainability pathways are reflected in rural development policies, we conducted a policy analysis, examining whether and to which extent national and local policy documents engaged with the indicators and descriptors of each pathway. For the policy analysis at the national level, we reviewed three key documents framing rural development policy: i) The White Paper of Rural Development (MLGM, 2019a), ii) National expectations for regional and local planning (MLGM, 2019b), and iii) The White Paper «Goals with meaning. Norway's action plan to achieve the sustainability goals by 2030» (MLGM, 2021). For the local level policy analysis, we reviewed the *municipal plans* of each of the 12 municipalities covered in our study (Askvoll, 2011; Bykle, 2016; Engerdal, 2018; Fjaler, 2014; Grue, 2020; Hyllestad, 2018; Lebesby, 2018; Rendalen, 2015; Solund, 2020; Sør-Aurdal, 2021; Vang, 2015; Vega, 2007). Municipal plans are critical tools in local policy and governance, as they outline key challenges for local community development and make strategic choices for future development (MCE, 2012).

Finally, based on the descriptors and indicators characterizing each pathway, we developed a four-dimensional "pathways axis" to illustrate how the policy documents position themselves with regards to competing pathways. For example, the green growth and degrowth pathways make competing claims on the need to increase or reduce production and consumption, and the nature protection and earth stewardships pathways make competing claims on the degree of compatibility between human presence and biodiversity protection. We illustrated the contrast between green growth and degrowth on a vertical axis, while nature protection and earth stewardship follow the horizontal axis (see Figure 2 in section 4.1.). Next, we positioned each of the three national policy documents on this axis, based on how the document engaged with the descriptors and indicators of each pathway. For the municipal plans, we identified the most salient goals related to each pathway and counted how many of the plans that emphasized each of these goals (one plan could mention several goals, such as protecting local rights and traditions related to farming and fishery, while also calling for reduced consumption).

Table 1: Criteria for identifying pathways in national and local policy documents

Drivers and solutions	Equity/ justice	Values of nature	Rural livelihoods	Relevant sources
Green growth				
Investments in environmentally harmful activities (such as fossil fuels) should be redirected towards green solutions (e.g., renewables) to reach a low carbon economy. Economic growth as a precondition for sustainability and emphasis on decoupling growth from environmental impacts through technological innovation and resource substitution.	Maximizing utility and sustainable wealth within planetary boundaries for present and future generations.	Nature as capital or as an asset for prosperity. Core underlying values include utilitarianism and (pareto optimal) efficiency. Instrumental and monetary value of nature emphasized. Assumes commensurability of diverse values of nature in money metrics for use in extended cost-benefit analysis.	Calls for investment in livelihoods with "growth-potential", such as digitalization, renewable energies, and nature-based tourism. Urges rural communities to strengthen market competitiveness through efficient use of natural capital and development of renewables at scale.	Martin et al. (2022); OECD (2017); Stoknes and Rockström (2018); World Bank (2012)
Degrowth				
Increased resource use and waste production driven by growth is seen as the core sustainability problem. Calls for abandoning GDP as measure of economic progress and for downscaling production and consumption to harmonize the economy with planetary boundaries.	Downscaling consumption in among rich countries and classes to fit safe and just operating space for humanity. Sufficiency and material equality are emphasized, with focus on expanding public services and the commons.	Emphasis on people's dependency on nature, as well as on reciprocity. Core values include diversity, egalitarianism, sufficiency, conviviality, and care. Emphasizes value incommensurability.	Downscaling and re-localizing production and consumption with attention to local and global environmental limits. Emphasis on enhancing quality of life and local autonomy, e.g., through work time reduction- and tax reforms.	D'Alisa et al. (2014); Georgescu-Roegen (2011); Hickel (2020); Kallis et al. (2020); Martin et al. (2022)
Earth Stewardship				
Top-down corporate and state intervention degrade nature and undermine local rights. Emphasis on local communities as territorial stewards, and the role of local and indigenous knowledge. Promotes local sovereignty and customary rights.	Emphasis on territorial rights of indigenous and peasant peoples, and the role of local and traditional knowledge.	Concerned with interconnectedness between people and nature. Core values are responsibility, and care/solidarity across species. Emphasis on relational values of nature and biocultural diversity.	Agrarian and other institutional reforms to enhance local control of the production of food, energy, and materials. Learn from, and safeguard, indigenous, local, and traditional knowledge.	Chapin III et al. (2009); Martin et al. (2022); Rozzi et al. (2015)
Nature protection				
Main driver of biodiversity loss is human encroachment into natural areas, and the failure to respect and care for other-than-human life. Argues for larger and stricter conservation areas, in which human interference is minimized.	Emphasis on ecological justice (justice between species) and future generations of human and non-human life.	Core values include ecocentrism, care/ solidarity across species, and responsibility. Emphasis on the intrinsic value of nature.	Restrict infrastructure development and economic activities that are harmful to nature. Long term (evolutionary scale) time frames.	Loreau et al. (2021); Martin et al. (2022); Miller et al. (2014); Wilson (2016)

3.2. Survey

We developed a survey in cooperation with the Norwegian Centre of Competence on Rural Development and with 12 rural municipalities in Norway representing a variety of geographical locations, nature types, and livelihood compositions. The survey had multiple objectives, including i) assessing local conceptions of sustainable development, ii) producing knowledge for national policy development (Skavhaug et al., 2022), and iii) producing insight for future sustainability planning. Data used for this research relates primarily to the survey's first objective[5].

The survey focused on visions for future community development and consisted of a combination of closed questions with choices on a 5-step scale (i) agree, ii) agree some, iii) neutral, iv) disagree some, v) disagree), and open questions to be answered by written comments. Answering the closed questions was mandatory to complete the survey, whereas it was optional to answer the open questions. Open questions included: i) "What does the concept of sustainable development entail to you?" and ii) "What type of livelihoods do you think the municipality should focus on in the future?". Background variables collected through the survey included: i) age, ii) gender, iii) years living in the municipality, iv) land-ownership status, v) education, and vi) income level.

The survey was tested with a pilot group consisting of representatives from national and regional governments (N=11) during autumn 2021, before it was revised and distributed in the municipalities between November 2021 and March 2022 (see figure 1). The survey was distributed online by the municipality administration, and participation was open to all inhabitants based on self-selection. Some municipalities also invited part-time inhabitants to respond to the survey, e.g., those owning a recreational home in the municipality[6]. No compensation was given for participating in the survey, and participation was anonymous (no personal information or IP-addresses were collected).

3.3. Data analysis

We used the answers from all respondents of the survey (N=3591) to conduct a text analysis of answers to open questions about sustainable development (N=927) and future livelihoods (N=404). Adopting an inductive approach, we first read all individual written answers and developed categories reflecting the most salient conceptions and wishes expressed by the respondents. For example, we categorized answers to the open question: "what does the concept of sustainable development entail to you?" in the six main categories: i) safeguarding resources for future generations, ii) protection of nature at the core, iii) sufficiency and/ or local production, iv) mainly social aspects, v) focus on profit and economic development, vi) uncertain (see Table 3 in section 4.2.), before we coded each reply into the most fitting category. Although these categories did not directly respond to the four pathways, they reflected values and conceptions associated with the different pathways. As an example, replies categorized under *'focus on profit and economic development'* mainly reflected an emphasis on instrumental values and nature as an asset (green growth), while replies in the category '*protection of nature at the core'* reflected elements of intrinsic and relational values (associated with the pathways of nature protection and degrowth). Next, we

[5] The Norwegian Centre for Competence of Rural Development were responsible for collection and storage of data associated with the survey. Data sets from closed questions in eight of the municipalities are published in reports on NCCRD webpages (NCCRD, 2022a; NCCRD, 2022b).

[6] Responses from part-time inhabitants (N=534) were considered equal to other inhabitants.

counted the number of replies corresponding to each main category, and calculated percentages related to the total number of respondents.

To compare how supporters of different pathways conceived sustainability and different livelihood options, we zoomed into the contrast between *green growth* and *degrowth* (vertical axis). We elicited profiles on respondents oriented towards either *green growth* or *degrowth* by filtering responses to five closed questions (Table 2). We thus applied rather strict requirements for categorizing respondents in either of these groups. This does not entail, however, that the remaining respondents do not sympathize with either of these pathways (or other pathways).

The 'green growth profile' covers respondents that agreed with claims that continued economic growth is a precondition for good quality of life, and that there is a need for expanding new, green businesses. Respondents in this group tend to trust that technology can solve most environmental problems, while they do not agree that there is an exaggerated focus on climate and environment. The 'degrowth profile' covers respondents that disagree with the claim that continued economic growth is a precondition for good quality of life, and that technology can solve most environmental problems. Respondents in this group agree that sustainable development entails willingness to change our way of life and disagree that there is exaggerated focus on climate and environment. As green growth supporters may variously agree or disagree that substantial lifestyle changes are needed (United Nations, 2022, SDG 12), this filter was left open. Furthermore, as degrowth supporters may both agree and disagree to claims regarding the need for new green business (see e.g., Fitzpatrick et al., 2022), this filter was also left open.

Table 2: Closed questions to measure attitudes aligned with green growth or degrowth

Closed questions	**Degrowth**	**Green growth**
Continued economic growth is a precondition for me to have a good quality of life	Disagree and disagree some	Agree and agree some
Sustainable development entails willingness to engage in lifestyle changes	Agree and agree some	No filter
Technological development can solve most environmental challenges	Disagree and disagree some	All except "disagree"
We should promote new green businesses	No filter	Agree and agree some
There is an exaggerated focus on climate and the environment	Disagree and disagree some	Disagree, disagree some, neutral

Table 2: Each closed question had the five response-alternatives: i) agree, ii) agree some, iii) either/or, iv) disagree some, iv) disagree.

After applying these filters, we retrieved and categorized written answers from the green growth and degrowth supporters according to the categories identified from the initial analysis of all written answers. Assessing answers from supporters of these two pathways, enabled us to conduct a comparison with sustainability conceptions and livelihood wishes expressed by the average of respondents, as well as with the descriptors signifying values and livelihood options associated with the *nature protection* and *earth stewardship* pathways (see Table 1).

4. Results

4.1. Sustainability pathways in policy documents

Overall, policy documents guiding rural development policies in Norway align with a green growth strategy with emphasis on green business and technological innovation for decarbonization.

The White Paper on Rural Development "Living local communities for the future" (MLGM, 2019a) identifies changing demographics and declining competitiveness in international markets as main challenges for rural areas in Norway, and presents increased economic growth, efficiency, and attractiveness as key remedies. The White Paper emphasizes that growth in population and workforce should be enabled through innovation, digitalization, and new "green" businesses and technologies. It further states that: "The most important means to promote living communities throughout Norway is a business sector that maintains and creates new profitable jobs" (MLGM, 2019a:8, our translation). Although segments of this document are distinctly aligned with a *green growth* pathway, it does not convey a clear sense of climate and environment crisis. Moreover, although some recommendations are compatible with both degrowth and earth stewardship, such as maintaining traditional agrarian practices, the report does not identify increased resource use driven by economic growth as a problem, nor does it call for reforms to strengthen local rights within farming and fishery. Rather, it emphasizes nature and culture as growth assets, noting how traditional knowledge and practices may promote niche markets, e.g., related to culinary tourism, and mentioning protected areas such as national parks as a driver of economic growth (ibid.).

The document *"National expectations for regional and local planning"* (MLGM, 2019b), provides overall guidelines for Norwegian municipality planning. This document reflects the broader policy consensus on *green growth*, and underlines the importance of increased efficiency: "When weighing different interests against each other in connection with planning, cost effectiveness is a priority in the overall assessment" (MLGM:9, 2019b). While climate change is described as key sustainability challenge, the document emphasizes an alleged decoupling of GDP from greenhouse gas emissions: "Despite economic growth and high population growth, Norway's total energy consumption has remained relatively stable in recent years, and greenhouse gas emissions are decreasing" (MLGM, 2019b:15). Moreover, although the document does call for measures to further reduce emissions from transport, building, and energy production, growth is not identified as an environmental problem, and there are no explicit calls for stabilizing per capita (household) consumption. Following the Biodiversity Act (Lovdata, 2009), the document stresses local governments' responsibility for nature protection, and calls for maintaining good ecological condition. Nature protection is presented under the overall heading of "growth-capable regions and local communities across the whole country", emphasizing its importance for growth. With regard to earth stewardship, the document argues that: "cultural heritage sites and cultural environments are non-renewable public assets that can form the basis for economic, social, cultural and environmental development" (MLGM, 2019b:16). It also emphasizes the importance of Sami livelihoods, e.g., through safeguarding areas for reindeer husbandry, while local governments are urged to ensure that "the needs of reindeer husbandry are balanced against other societal interests" (MLGM, 2019b:19).

The White Paper «Goals with meaning. Norway's action plan to achieve the sustainability goals by 2030» (MLGM, 2021) frames Norwegian efforts towards achieving the SDGs. This document has a distinct green growth framing, stating in the introduction that:

> "(...) a sustainable society requires economic growth and value creation. The government therefore believes that one of the main strategies to achieve the sustainability goals by 2030 must be to create more jobs, include more people in working life and do what we can to ensure economic growth in the years to come" (MLGM, 2021:8, our translation).

In line with a degrowth pathway, the document acknowledge that high consumption levels have negative "spill-over effects", e.g., in terms of emissions embedded in imported goods (SDG 12). However, the prospect for decoupling consumption from environmental impact through a circular economy is emphasized (SDG 8, SDG 12). In line with some elements of the degrowth pathway, the White Paper calls for developing 'area accountancy' and improving incentives for municipalities to enhance common goods provided by nature (MLGM, 2021:162, SDG 15). In contrast to the degrowth pathway, growth is not framed as a problem for the environment, nor are there any calls for larger conservation areas[7] or for agrarian reforms along the lines of the nature protection and earth stewardship pathways.

The *municipal plans* (N=12) show great variety in content and in the framing of sustainability problems and solutions. The municipal plans are overall closely aligned with the national guidelines for rural policy development (MLGM, 2019b), and associated green growth strategies, referring to "sustainable economic growth" or "growth with less environmental impact". Ten of the 12 assessed plans refer to growth in population, business, and workplaces as key aims for local development, and most plans (N=11) emphasize that nature and protected areas should be utilized for economic growth within tourism. Moreover, several plans (N=7) highlight the importance of maintaining traditional livelihoods, albeit often as drivers of growth for the tourist industry. Sustainability issues are less prominent in older plans (before 2019), while newer plans (N=3) and plans under development (N=2) adopt the SDGs as an overall framing. The majority of plans contain detailed demographic statistics but display limited information on environmental accounts such as land, energy, and material use. Environmental measures are typically focused on climate issues, and only two out of the 12 revised municipal plans acknowledge biodiversity loss as a local sustainability challenge. Some plans promote strategies that engage with elements of competing sustainability pathways. For example, although three plans emphasize the need for reduced consumption (in line with a degrowth pathway), the same documents also call for an expansion of green industry and increased energy production (in line with a green growth pathway).

Overall, the assessed policy documents emphasize *green growth* as the preferred sustainability pathway, with an associated emphasis on efficiency, utility, and instrumental values of nature and culture, while giving limited attention to relational or intrinsic values (see Figure 2). Calls for protecting both nature and traditional livelihood practices are specifically linked to market adaptation and framed as drivers of economic growth and prosperity. Even in documents that engage with elements of a degrowth pathway, arguments for economic growth dominate.

[7] Beyond the established goal of increasing the share of protected forests from 5.5% to 10% (of the total Norwegian forest area), using mainly the payments for ecosystem services (PES)-like scheme of 'voluntary conservation' (see e.g., Frivillig Vern, 2022).

Figure 2: Illustration of relative support to competing sustainability pathways in the assessed policy documents

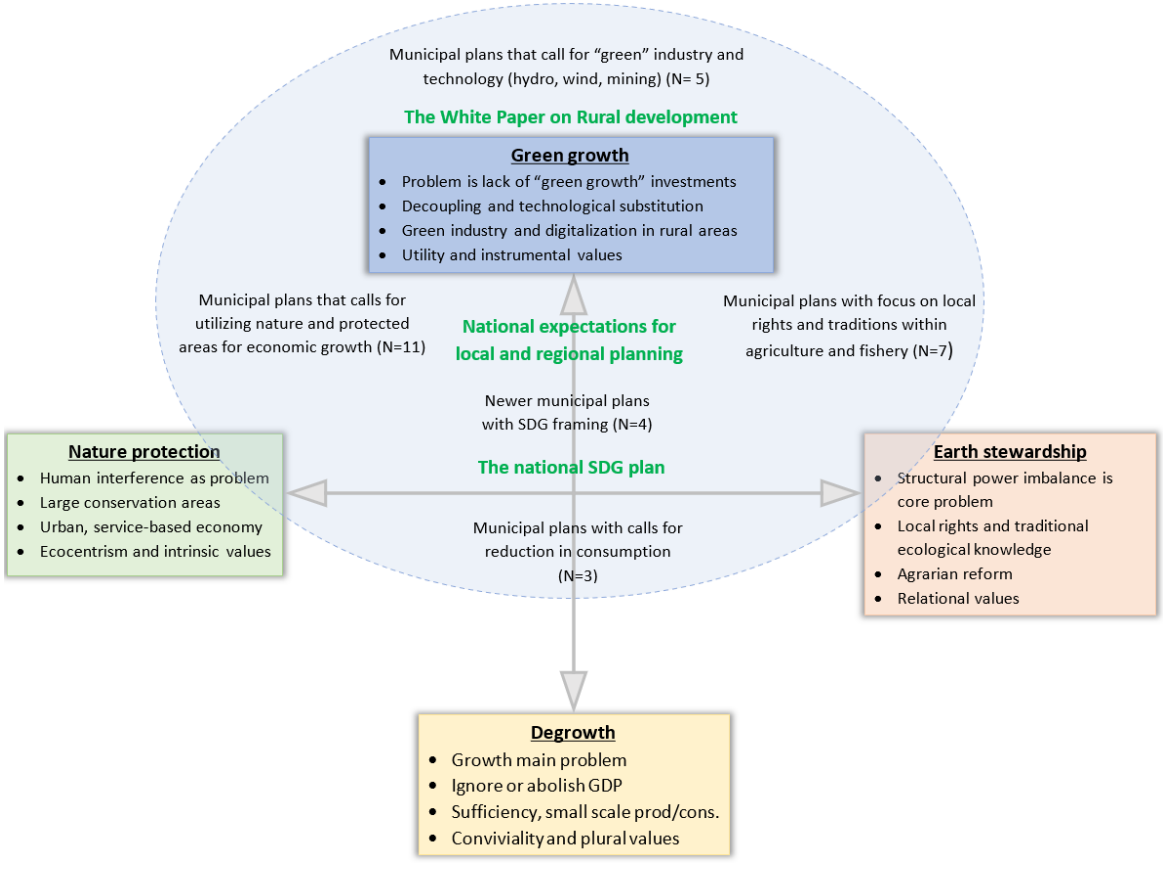


Figure 2: The four-dimensional axis illustrates how policy documents reflect contrasts and synergies between competing pathways. Contrasts between green economy and degrowth are depicted in the vertical axis; contrasts between nature protection and earth stewardship are depicted the horizontal axis. National policy documents indicated by green color. N indicates the number of municipal plans that emphasized a specific ambition. One plan may emphasize several ambitions.

4.2. Survey results

In total, 3591 respondents started the survey responding to parts of it and 2261 respondents completed the entire survey. 13.1% of respondents expressed explicit support to a *green growth* pathway (N=471) and 5.2% were characterized as *degrowth* supporters (N=187). Other respondents present mixed profiles, including elements and values connected to different pathways. See table A.1., A.2., and A.3. in appendix A for overview of respondents across different groups and socio-demographic categories. Table 3 gives an overview of what different groups emphasized in their replies to the open questions about sustainable development and future livelihoods.

Table 3: Answers to open questions by main categories and groups of respondents, rural Norway, 2021-2022

What does the concept of sustainable development entail to you?			
	All respondents (N= 927)	Green growth supporters (N=155)	Degrowth supporters (N=102)
Safeguarding resources for future generations	32.9%	42.6%	23.5%
Protection of nature at the core	19%	11%	44.1%
Sufficiency and/ or local production	7.1%	6.4%	7.8%
Mainly social aspects	15.9%	16.1%	10.8%
Focus on profit and economic development	17.5%	20%	9.8%
Uncertain	7.6%	3.9%	4%
What type of livelihoods do you think the municipality should focus on in the future?			
	All respondents (N=404)	Green growth supporters (N=62)	Degrowth supporters (N=54)
Primary sector (agriculture, fishery, forestry)	42.8%	44.3%	65%
Tourism	39.4%	55.7%	42.6%
Culture and art	7.2%	4.9%	27.8%
Industry (also including wind- and hydro power)	17.6%	21.3%	3.7%
Aquaculture	13.1%	21.3%	5.5%
Tech and IT	5.9%	4.9%	9.6%
Knowledge and research	5.7%	0%	13%

Table 3: N=xx shows the number of individual answers to each question. For the first question (sustainable development), each answer was sorted into *one* main category, and the number of answers within each group adds up to 100%. For the second question (livelihood preferences), several of the respondents mentioned two or more alternatives, and the percentage show the *share of respondents within each group* (e.g., degrowth supporters) that mentioned the specific type of livelihood (thus, this does not add up to 100% within the group). Note that the category of "all respondents" also includes the answers from degrowth and green growth supporters.

4.2.1. Rural conceptions of sustainable development

In their conceptions of *sustainable development*, one third (32.9%) of respondents emphasized the need to safeguard resources for future generations (see Table 3 and Figure 3). Answers in this category both stressed instrumental values and people's dependency on nature, combined with care and equity in human-human relationship, and can thus be associated with elements of both green growth, degrowth, and earth stewardship. One fifth (19%) of respondents perceived protection of nature as the core of sustainable development. These replies reflected ecocentrism and intrinsic values, associated with both a nature protection and a degrowth pathway. Next, 7.1% of the answers referred to sufficiency, often in combination with calls for local production, which are closely aligned

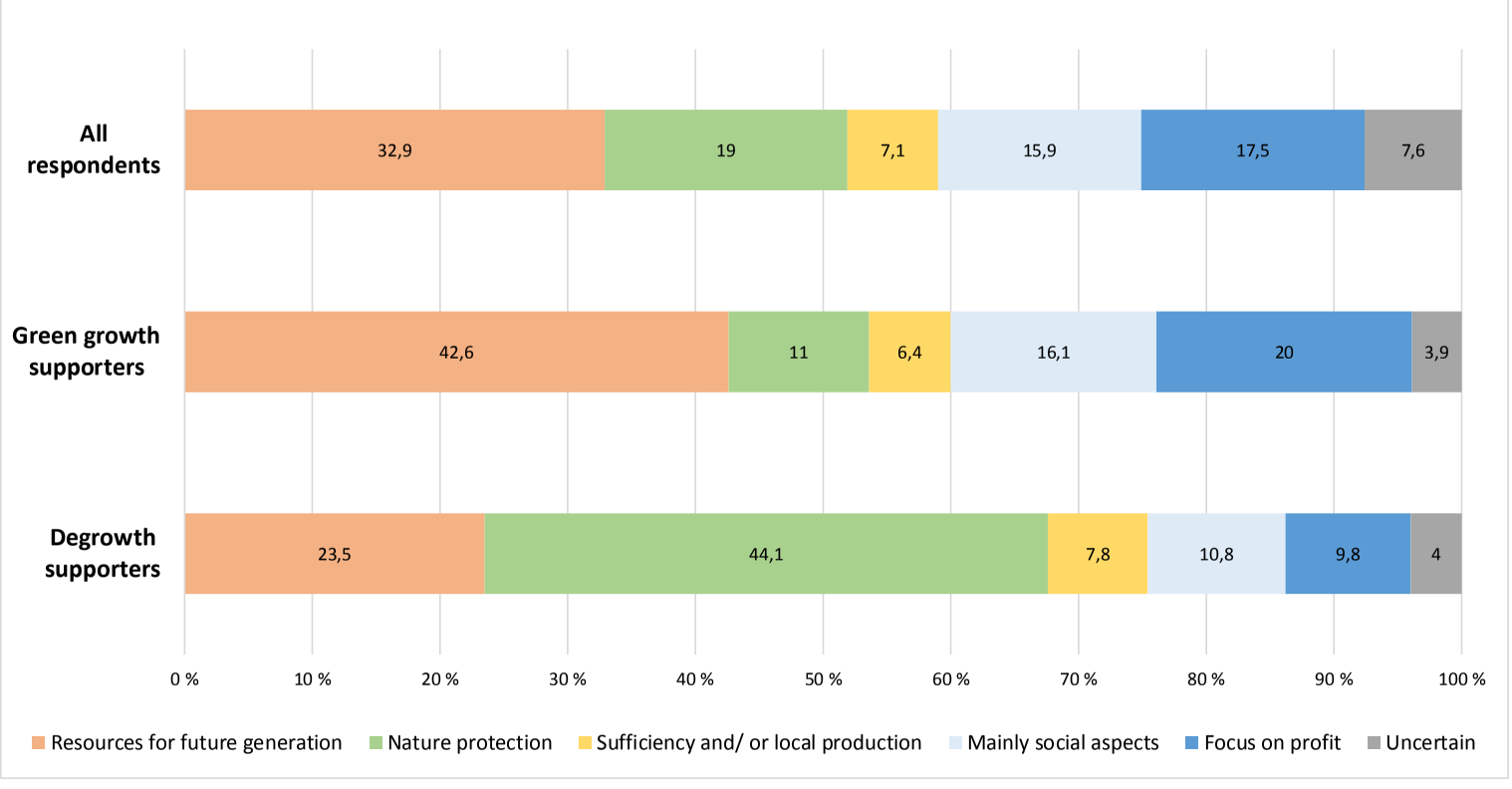
with the pathways of degrowth and earth stewardship. We also found that 15.9% of respondents focused mainly on social aspects, such as improved health care or changes in local governance. These answers pointed to both instrumental and relational values in human-human relationships, but were detached from environmental dimensions, and thus not directly associated with any of the sustainability pathways. Lastly, close to one fifth (17.5%) of respondents emphasized profit and economic development as core aspects of sustainable development. This focus on nature as capital or as an asset for prosperity, is aligned with a green growth pathway. However, arguments in this category also varied between those calling for "green" growth, and those concerned with traditional economic growth.

These answers hints to the complexity of diverse sustainability conceptions and indicate that rural inhabitants hold views that align with competing sustainability pathways. We note three interesting results. First, although a green growth pathway dominates the sustainability thinking in policy agendas for rural development, only 17.5% of respondents emphasize profit or economic growth as a key dimension of sustainable development. However, one third of the answers mainly emphasized economic (17.5%) or social (15.9%) dimensions of sustainable development, with less (or no) attention to the environmental dimension. Third, through stressing nature protection, sufficiency, or local production, one fourth (26.1%) of the respondents expressed sustainability conceptions closely aligned with the pathways of nature protection, degrowth, or earth stewardship.

The comparison of answers from *green growth* and *degrowth* supporters, show that 42.5% of green growth supporters understand sustainable development as primarily consisting of safeguarding resources for future generations, and that a substantial share (23.5%) of degrowth supporters also share this view. Moreover, while 44.1% of the degrowth supporters emphasize nature protection, only 11% of green growth supporters place nature protection at the center of sustainability. The understanding of sustainable development as entailing sufficiency, decreased consumption, or local production, is relatively equally shared across the groups (6-7%). Lastly, green growth supporters more frequently conceive of sustainable development to primarily entail socio-economic aspects (36.1%), compared to those in the degrowth group (20.6%), where environmental aspects are more strongly emphasized.

These results indicate that green growth supporters primarily emphasize instrumental values and nature as capital or as an asset for prosperity, while degrowth supporters emphasize intrinsic values, and care and reciprocity in human-nature relationships. Thus, the results e.g., hint to a strong relationship between the pathways of degrowth and nature protection.

Figure 3: Answers to open question about what sustainable development entails, rural Norway, 2021-2022



4.2.2. Livelihood preferences

When asked about the type of livelihoods the municipality should pursue in the future, the average respondent expressed strong support to livelihoods within the primary sector such as agriculture, forestry, fishery, or forestry (42.8%), but also to tourism (39.4%).

Comparison across groups shows that 55.7% of green growth supporters mention tourism, while 44.3% call for agriculture, forestry, and fisheries (see Table 3 and Figure 4). Amongst degrowth supporters, primary sector is even more highly valued (65%), while 42,6% call for more tourism. In contrast to green growth supporters, degrowth supporters frequently specify wishes for small-scale food production (some mention regenerative and organic practices) and sustainable and nature-based tourism. Both aquaculture (21.3%) and industry (21.3) rank significantly higher among green growth supporters, than among degrowth supporters (3.7% and 5.5%). Degrowth supporters, however, envision a livelihood composition with stronger elements of culture and art (27.8%) and knowledge and research (13%). There is no mention of knowledge and research in replies from respondents categorized as green growth supporters.

Figure 4: Answers to open question about desired livelihoods, rural Norway, 2021-2022

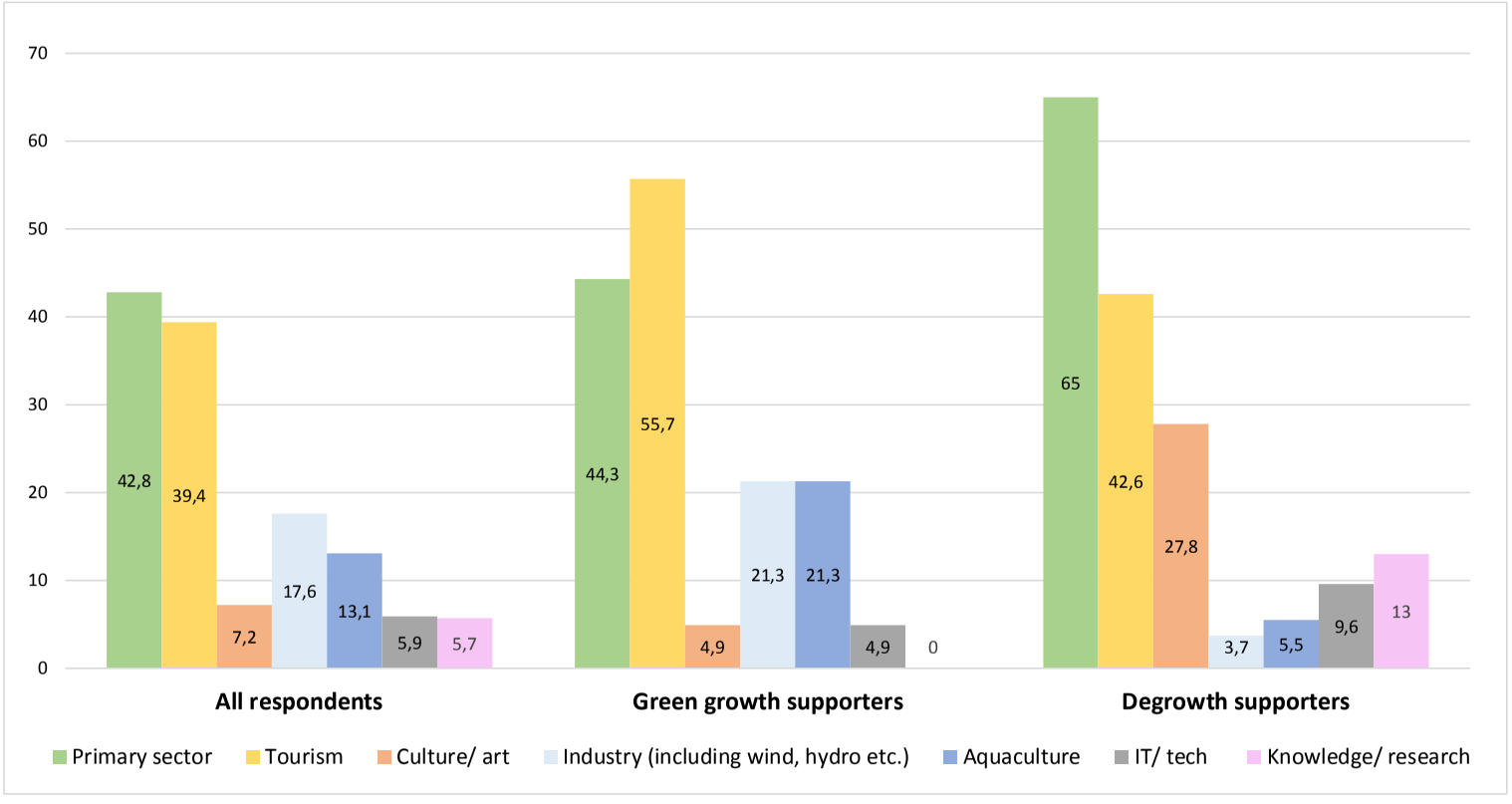


Figure 4: Percent in this figure show the share of respondents within each of the groups that mentioned the specific livelihood (does not add up to 100%).

5. Conclusion

Rural communities across the world are striving to engage in sustainability pathways to reach the SDGs, often in challenging contexts characterized by rural exodus, decline of traditional land uses and local knowledge systems, and growing pressures from infrastructure development.

Using rural Norway as a case, we examined how values and livelihood options associated with competing sustainability pathways are supported in rural policy agendas and how values and pathways are reflected in people's sustainability conceptions and livelihood preferences. Three main results are highlighted.

First, Norwegian rural policy is dominated by a *green growth* policy consensus. The pathways of *nature protection* and *earth stewardship* get partial recognition in policy agendas, e.g., through an acknowledgement of ecological and cultural values. However, these values are often praised primarily as drivers of economic growth. Only timid support was found to elements of a degrowth pathway, reflected in calls to reducing energy and other resource use. While a few of the municipal plans emphasize the rights of local communities as custodians of biodiversity and natural resources (earth stewardship), none of the assessed national or local documents calls for shifting the focus from growth towards well-being and favoring small-scale local production (degrowth), or for significant expansion of natural protected areas (nature protection). Sustainability issues remain vaguely addressed in the older municipal plans, whereas the newer plans adopt the SDGs according to the precepts of a green growth pathway. The envisioned green growth pathway for rural Norway promotes utility, efficiency, and instrumental values, and it is communicated as a 'green shift' by means of technological innovation, green industry, and nature-based tourism. Although intrinsic and relational/cultural values are partly embedded in laws and regulations, such as the Biodiversity Act (Lovdata, 2009), such values are seemingly surpassed in rural policy documents by calls for utility and efficiency.

Second, survey results (N=3591) show that rural people in Norway hold more diverse values and livelihood preferences than what is reflected in current green growth policies. As an example, while 17.5% of survey respondents describe profit or economic growth as a key dimension of sustainable development, one fourth (26.1%) emphasize nature protection, sufficiency, or local production. Moreover, and in contrast to the green growth pathway (OECD, 2006), 44.5% of respondents call for their municipality to stimulate livelihoods within primary sector, such as agriculture, forestry, or fishery.

Third, 13.1% of respondents explicitly support a *green growth* pathway (N= 471), while 5.2% support a degrowth pathway. Moreover, while green growth supporters stress instrumental values and the safeguarding of resource for future generations, degrowth supporters emphasize care for nature (intrinsic values), and small-scale production within primary sector (relational values). However, although degrowth supporters expresses sustainability-aligned values such as care for nature, this pathway lacks institutional recognition in national and local policies.

Overall, our results indicate that current policies agendas for rural Norway provide a limited scope for deliberating on competing sustainability pathways beyond green growth. We deem this concerning for at least three reasons. First, IPBES has identified a short-term focus on growth and

market-dominated values to be a major driver of global environmental decline, yet Norwegian rural policy retains a focus on growth and market competitiveness at the expense of ecological (intrinsic) and cultural (relational) values. Second, economic growth remains unquestioned, despite mounting research indicating that consumption levels in Norway entail per capita overshoots of planetary boundaries, and despite evidence of a lack decoupling of growth from environmental impacts at the pace and scale required to meet international sustainability targets. Finally, because mounting research points to a structural connection between economic growth (with associated growth in resource and carbon footprints) and environmental conflicts at the extraction and commodity frontiers, a clear example in Norway being the growing conflict between green energy development and the traditional livelihoods of Sami people. Following recommendations of the IPBES Values Assessment, we argue that Norwegian rural policies should transcend its focus on green growth, broadening the scope of rural development policies towards values and livelihood options associated with a more diverse set of sustainability pathways, including degrowth, earth stewardship and nature protection in order to achieve a better balance of ecological, cultural and economic values and as a strategy to prevent or reduce environmental conflicts resulting from the growth economy.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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APPENDIX A

Table A.1: All survey respondents: Overview of socio-demographic characteristics

Variable	Level	Counts	Total	Proportion
Gender	Male	1591	3591	0.443
	Female	1958	3591	0.545
	Other	11	3591	0.003
	Do not want to say	31	3591	0.009
Age	13-15	118	3593	0.033
	16-19	94	3593	0.026
	20-24	165	3593	0.046
	25-34	512	3593	0.142
	35-49	1014	3593	0.282
	50-66	1286	3593	0.358
	67-75	310	3593	0.086
	76+	94	3593	0.026
Landowner	Yes	894	3309	0.270
	No	2415	3309	0.730
Education	Elementary school	79	2145	0.037
	Vocational school	209	2145	0.097
	High school	586	2145	0.273
	College/university up to 3 years	664	2145	0.310
	College university 3 years+	607	2145	0.283
Income	Up to 150 000	29	2129	0.014
	150 000 – 249 999	84	2129	0.039
	250 000 – 349 999	203	2129	0.095
	350 000 – 449 999	284	2129	0.133
	450 000 – 559 999	414	2129	0.194
	550 000 – 649 999	631	2129	0.296
	750 000 +	242	2129	0.114
	1 mill +	131	2129	0.062
	Do not know/ do not want to say	111	2129	0.052
Years lived	Less than 1 year	74	2999	0.025
	1 - 2 years	104	2999	0.035
	3 - 4 years	131	2999	0.044
	5- 14 years	455	2999	0.152
	15 years or more	2235	2999	0.745
Attachement	Born and raised in munic.	1259	2998	0.420
	Lived away, but moved back	483	2998	0.161
	Moved to munic. when young	178	2998	0.059
	Moved to munic. as adult	1025	2998	0.342
	Have built/bought/ inherited cabin	53	2998	0.018

Table A.1.: proportion adds up to 100% within each category. Those in the age groups between 13-19 did not get questions about education and income.

Table A.2: Green growth supporters: overview of socio-demographic characteristics

Variable	Level	Counts	Total	Proportion
Gender	Male	178	471	0.378
	Female	290	471	0.616
	Other	1	471	0.002
	Do not want to say	2	471	0.004
Age	13-15	13	471	0.028
	16- 19	13	471	0.028
	20-24	16	471	0.034
	25-34	73	471	0.155
	35-49	131	471	0.278
	50-66	174	471	0.369
	67-75	37	471	0.079
	76+	14	471	0.030
Landowner	Yes	115	445	0.258
	No	330	445	0.742
Education	Elementary school	14	441	0.032
	Vocational school	42	441	0.095
	High school	88	441	0.200
	College/university up to 3 years	151	441	0.342
	College university 3 years+	146	441	0.331
Income	Up to 150 000	6	437	0.014
	150 000 – 249 999	14	437	0.032
	250 000 – 349 999	42	437	0.096
	350 000 – 449 999	55	437	0.126
	450 000 – 559 999	79	437	0.181
	550 000 – 649 999	143	437	0.327
	750 000 +	45	437	0.103
	1 mill +	31	437	0.071
	Do not know/ do not want to say	22	437	0.050
Years lived in munic.	Less than 1 year	10	405	0.025
	1 - 2 years	16	405	0.040
	3 - 4 years	15	405	0.037
	5- 14 years	55	405	0.136
	15 years or more	309	405	0.763
Attachement	Born and raised in munic.	148	405	0.365
	Lived away, but moved back	78	405	0.193
	Moved to munic. when young	23	405	0.057
	Moved to munic. as adult	151	405	0.373
	Have built/bought/ inherited cabin	5	405	0.012

Table A.2.: proportion adds up to 100% within each category. Those in the age groups between 13-19 did not get questions about education and income.

Table A.3: Degrowth supporters: Overview of socio-demographic characteristics

Variable	Level	Counts	Total	Proportion
Gender	Male	91	187	0.487
	Female	94	187	0.503
	Other	-	-	-
	Do not want to say	2	187	0.011
Age	13-15	-	-	-
	16-19	-	-	-
	20-24	1	187	0.005
	25-34	24	187	0.128
	35-49	65	187	0.348
	50-66	70	187	0.374
	67-75	24	187	0.128
	76+	3	187	0.016
Landowner	Yes	68	187	0.364
	No	119	187	0.636
Education	Elementary school	3	186	0.016
	Vocational school	5	186	0.027
	High school	22	186	0.118
	College/university up to 3 years	55	186	0.296
	College university 3 years+	101	186	0.543
Income	Up to 150 000	4	185	0.022
	150 000 – 249 999	4	185	0.022
	250 000 – 349 999	17	185	0.092
	350 000 – 449 999	18	185	0.097
	450 000 – 559 999	38	185	0.205
	550 000 – 649 999	62	185	0.335
	750 000 +	19	185	0.103
	1 mill +	12	185	0.065
	Do not know/ do not want to say	11	185	0.059
Years lived in municip.	Less than 1 year	11	158	0.070
	1 - 2 years	12	158	0.076
	3 - 4 years	13	158	0.082
	5- 14 years	30	158	0.190
	15 years or more	92	158	0.582
Attachement	Born and raised in munic.	28	158	0.177
	Lived away, but moved back	33	158	0.209
	Moved to munic. when young	6	158	0.038
	Moved to munic. as adult	89	158	0.563
	Have built/bought/ inherited cabin	2	158	0.013

Table A.3.: proportion adds up to 100% within each category. Those in the age groups between 13-19 did not get questions about education and income.

APPENDICES

A.1. Semi-structured interview guide (translated to English)

Presentation of the research project (ECOREAL)

- The project's purpose and organization
- Underline the informant's rights
- Ask about future use of data

About the informant

- The informant introduces her/himself (background and current role)
- What does the forest mean to you?
- What is your role in [organization] and how long have you worked there?

The organization of the forest governance field

- What is the state of the forest? (ecological condition)
- How is the forest as a political arena?
- Who works together and how does this take place?
- Who gets their opinions heard?
- What role do local communities play in forest governance today?
  (with local communities we e.g., think of a municipality, but perhaps primarily the ordinary citizens of a municipality - do they have a role in forest management? Should this role be different?
- Do you feel that there is any discussion about the role of local communities/civil society in forest management?

Forestry

- How is the forest managed today?
- How should the forest be managed, and why?
- What are drivers and barriers for change?

The forest's contribution to sustainable community development

- What does the forest mean to Norwegian local communities? (has the importance of the forest changed in the last 50 years, in what way?)
- What are the most important values that the forest contributes to our society? (are these values recognized?)
- Do you have examples of cases that you believe illustrate well that different values from forests are safeguarded in decision-making processes? Or possibly the opposite; that different values from forests are not recognized or included in decision-making processes?
- What comes to your mind when I say “bioeconomy”? From your perspective - what is the forest's role in a possible bioeconomy?
- (Does one have to make some trade-offs, or all "good goals" for the forest be achieved?)

Other

- Did we forget something?
- Who else should we talk to?

A.2. Information letter to interview informants

Invitasjons- og informasjonsbrev
til flere mottakere

Deres ref:
Vår ref: 196/2020-471.01

Sted: Oslo
Dato:

Forespørsel om deltakelse i intervju i forskningsprosjekt om forvaltning av skogen i Norge. "Real-world ecosystem management: Identifying knowledge gaps and overcoming societal barriers" (ECOREAL)

Norsk institutt for naturforskning (NINA) har sammen med Norges miljø- og biovitenskapelige universitet (NMBU) og Fridtjof Nansens institutt (FNI) satt i gang et forskningsprosjekt som skal undersøke samfunnsmessige forhold som påvirker muligheten til å forvalte skog på økosystemnivå. Prosjektet "Real-world ecosystem management: Identifying knowledge gaps and overcoming societal barriers" (ECOREAL) er finansiert av Norges Forskningsråd og skal vare i noe over fire år fra oppstarten høsten 2019. Vi vil gjerne gjøre et forskningsintervju med deg som et ledd i gjennomføringen av prosjektet.

ECOREAL er et tverrfaglig forskingsprosjekt med mål om å identifisere kunnskapshull og kartlegge institusjonelle, sosiale, juridiske og økonomiske barrierer mot implementering av økosystemperspektiver i skogforvaltningen. Bakgrunnen for prosjektet er at det ikke er nok å ta vare på enkeltarter og mindre områder for å bevare funksjonelle økosystemer for ettertida. Økosystemperspektivet finnes allerede i nasjonal lovgivning så vel som i internasjonale konvensjoner som Norge har tiltrådt, men om perspektivet har tilstrekkelig innflytelse i praktisk forvaltning, er et spørsmål det finnes ulike meninger om. Det er en målsetningen for prosjektet å identifisere eventuelle barrierer i det eksisterende forvaltningsregimet.

Skogen inneholder 48 % av arter som er truet i Norge (Henriksen og Hilmo 2015)[1]. Selv om viktige indikatorer for økologisk tilstand i skog (som mengde død ved) har økt de siste par tiårene, er den økologiske tilstanden for skog i Norge langt fra referansenivået i skog med liten menneskelig påvirkning (Jacobsen og Pedersen 2020)[2]. Det er imidlertid uenighet om hva som er et økologisk bærekraftig skogbruk og hvordan ulike hensyn skal vektlegges begrunnes. Det er derfor svært viktig at mangfoldet av synspunkter er representert blant de som stiller opp til intervju. To doktorgrader, en på Universitet i Oslo og en på NMBU i Ås, er avhengig av at vi får fram variasjonen i oppfatninger om tilstanden i skogen.

ECOREAL er inndelt i fem såkalte arbeidspakker, som du kan lese om i vedlagte presentasjon. Vi legger også ved prosjektbeskrivelsen på engelsk slik den ble sendt til Norges forskningsråd.

Datalagring og informantrettigheter
For å sikre datakvaliteten ønsker vi å ta opp intervjuene elektronisk. I tråd med norsk personvernlovgivning og alminnelig etiske retningslinjer i forskning vil alle utsagn som gjengis i rapportering fra prosjektet, bli anonymisert. Unntak kan gjøres hvis informanten tydelig opptrer i rollen som representant for en institusjon eller organisasjon, og selv godtar eller foretrekker at sitater knyttes til navngitt person. Dette må det i så fall gjøres avtale om, og vedkommende vil da få forhåndsgodkjenne eventuelle sitater.

[1] Henriksen S. og Hilmo O. (red.) 2015. Norsk rødliste for arter 2015. Artsdatabanken, Norge
[2] Jakobsson, S. & Pedersen, B. (red.) 2020. Naturindeks for Norge 2020. Tilstand og utvikling for biologisk mangfold. NINA Rapport 1886. Norsk institutt for naturforskning.

Samtlige lydopptak slettes etter at prosjektet er slutt (september 2023). Intervjuutskrifter (transkriberte intervjuer) anonymiseres ved at alle opplysninger som kan bidra til identifikasjon av personer fjernes (også i de deler av utskriftene som ikke blir gjengitt i rapportering fra prosjektet). Dette skjer i forbindelse med selve transkriberingen. Det betyr at det ikke på noe tidspunkt vil finnes utskrifter som ikke er anonymisert. Lydopptak og utskrifter oppbevares på en sikker server hos NINA i henhold til datahåndteringsplan godkjent av Norges forskningsråd. Utskrifter i anonymisert form kan etter avtale bli overlevert NSD - Norsk senter for forskningsdata etter prosjektslutt i september 2023.

Alle har rett til å trekke seg fra prosjektet på et hvilket som helst tidspunkt, også etter at intervjuene er gjennomført. Opptak og utskrifter vil da bli slettet.

NSD – Norsk senter for forskningsdata har vurdert at behandlingen av personopplysninger i dette prosjektet er i samsvar med personvernregelverket. NSD er også personvernombud for NINA. Hvis du har spørsmål knyttet til NSD sin vurdering av prosjektet, kan du ta kontakt med NSD – Norsk senter for forskningsdata på epost (personverntjenester@nsd.no) eller på telefon: 55 58 21 17.

Ta gjerne kontakt med oss på NINA om noe er uklart, eller om det er noe du vil diskutere med oss. Kontaktinformasjon finner du nederst i brevet.

Med hilsen

Kristin Thorsrud Teien
Forskningssjef

Håkon Aspøy
Stipendiat

Kontaktinfo:
kristin.teien@nina.no
hakon.aspoy@nina.no
ketil.skogen@nina.no
Tel. 73 80 14 00

Kort presentasjon av arbeidspakkene i ECOREAL

Arbeidspakke 1 har som hovedmål å undersøke i hvilken grad de ulike sidene ved økosystembasert forvaltning fanges opp i dagens nordiske forvaltning av skogøkosystemene. Den første delen av arbeidet omfatter å analysere hva økosystembasert forvaltning innebærer i økologisk forstand, dvs. hvordan begreper brukt om økosystembasert forvaltning kan forstås som konkrete egenskaper ved økosystemenes ulike strukturer og funksjoner (for eksempel karbonlagring) i form av indikatorer for skogens økologiske tilstand. Deretter vil vi vurdere i hvilken grad og hvordan dagens forvaltning av skog forholder seg til disse økologiske egenskapene, og hvilke typer av slike egenskaper som i liten grad blir ivaretatt gjennom forvaltningen av skogen. Deretter vil vi se om kunnskap og data om de ulike egenskapene ved skogens økologiske tilstand er tilgjengelig i hensiktsmessig form, eller om slik kunnskap mangler eller ikke er gjort tilgjengelig. Endelig vil vi vurdere om tilgjengelig kunnskap om de ulike egenskapene ved skogens økologiske tilstand faktisk blir tatt i bruk i forvaltningen av skog i ulike sektorer.

Arbeidspakke 2 handler om lovverket som regulerer skogbruk i Norge. Vi vil skille mellom fire kjerneelementer i det juridiske rammeverket, og undersøke hvordan de påvirker mulighetene til å forvalte skog på økosystemnivå: 1) Relevante aktørers rettigheter og plikter, inkludert grunneiere, frivillige organisasjoner, offentlige myndigheter, skogandelslag og de som er involvert i sertifisering av skogbruk eller skogsprodukter; 2) Beslutningsmyndigheten som lovgivningen fordeler mellom offentlige myndigheter, samt beslutninger om å delegere slik myndighet videre til andre myndighetsorganer og private aktører; 3) De prosessuelle kravene til slike beslutninger, herunder regler om konsekvensutredninger og åpenhet om beslutningsprosesser; og 4) de viktigste egenskapene til relevante institusjoner, ikke minst de som er viktige for deres forhold til andre institusjoner og aktører.

Arbeidspakke 3 har som sin sentrale hypotese at maktforholdene på skogfeltet er blant barrierene som vanskeliggjør økosystembasert forvaltning. Vi skal: 1) Kartlegge aktørene på skogfeltet og studere hvilke allianser de ulike aktørene de inngår i. 2) Studere maktrelasjoner mellom ulike aktørgrupper. 3) Undersøke hvilke interesser som vinner fram i den praktiske skogforvaltningen, og hvilke maktressurser de dominerende grupperingene besitter. Doktoravhandlingen som skal leveres Universitet i Oslo er knyttet til denne arbeidspakken.

Arbeidspakke 4 tar for seg vitenskap og styringsteknologier. Her vil vi undersøke på hvilke måter vitenskapelig kunnskap og ulike forvaltningsverktøy bidrar til, eller er til hinder for, økosystembasert forvaltning av skog. Vi skal: 1) Kartlegge hvilke typer kunnskap og forvaltningsverktøy som i praksis brukes i beslutninger i skogforvaltningen. 2) Analysere hvordan økosystemene blir begrepsfestet, og i hvilken grad ulike definisjoner og vurderingsverktøy får konsekvenser for den praktiske forvaltningen. 3) Undersøke i hvilken grad kunnskap og forvaltningsverktøy er gjenstand for kontrovers, og inngår i sosiale konflikter mellom ulike interesser.

Arbeidspakke 5 ser på forholdet mellom økonomi og skogforvaltning, og har tre hovedmål: 1) Kartlegge, beskrive og fylle kunnskapshull når det gjelder verdien av skog og skogen sine økosystemtjenester i Norge, med særlig vekt på sosiale, kulturelle og økonomiske verdier. 2) Undersøke myndighetsstrukturer og styringsprosesser, og kartlegge økonomiske virkemidler som påvirker forvaltning og bruk av skogøkosystem i Norge. Økonomiske virkemidler kan inkludere skatter, subsidier, sertifiseringsordninger og andre markeds- og

betalingsordninger. Slike økonomiske virkemidler vil bli sett i sammenheng med bruken av legale, pedagogiske og administrative virkemidler, for å vurdere hvordan, og i hvilken grad, disse samlet gir grunnlag for en helhetlig politikk på området. 3) Undersøke både risiko og muligheter knyttet til implementering av ulike økonomiske virkemidler og andre tiltak for forvaltning av skogøkosystemer. Dette kan blant annet innebære å se nærmere på hvilke effekter det å gjøre naturgoder til omsettbare varer kan ha på forhold som påvirker handlingsvalg og praksiser. Doktoravhandlingen som skal leveres NMBU er knyttet til denne arbeidspakken.

Arbeidspakke 6 handler om integrering. Den skal trekke trådene sammen fra de fem første arbeidspakkene, og dessuten sørge for at forumet fungerer godt. Hensikten med forumet er både legge til rette for dialog og å få fram ulike perspektiver på skog og skogbruk på en slik måte at kunnskapen om disse ulike perspektivene (ulike måter å forstår skogbiologi og skogbruk på, fra ulike utgangspunkter) kan systematiseres av forskerne.

A.3. Information to survey respondents

Har du lyst til å delta i en spørreundersøkelse om framtidig utvikling i din kommune?

Vi ønsker å høre din mening om hva som er viktig for å skape et livskraftig og bærekraftig lokalsamfunn i framtida

Kommunen din, Distriktssenteret og Norges miljø- og biovitenskaplige universitet (NMBU) vil ha stor nytte av svarene dine i prosjekter og forskning knyttet til lokal og nasjonal samfunnsutvikling. Resultater fra undersøkelsen blir gjort tilgjengelig på nettsidene til kommunen.

Undersøkelsen er **helt anonym**.
Det tar ca. 15 - 20 minutt å svare, avhengig av hvor mye du ønsker å skrive i valgfrie felt. Svarene blir lagret underveis, så dine innspill blir registrert selv om du ikke rekker å gjennomføre hele undersøkelsen.

I denne undersøkelsen ønsker vi svar fra deg som er 13 år (ungdomsskolen) og eldre i kommunen.
Bor du ikke i kommunen, men har hytte/fritidsbolig, kan du krysse av for deltidsinnbygger i starten av undersøkelsen. Da svarer du på spørsmålene i undersøkelsen med utgangspunkt i kommunen du har hytte i.

Dersom du har spørsmål, kan du ta kontakt med Distriktssenteret:
Ragnhild Godal: ragnhild.godal@kdu.no
eller Elisabeth Veivåg Helseth: elisabeth.helseth@kdu.no

Distriktssenteret
Kompetansesenter for distriktsutvikling

Tusen takk for at du tar deg tid til å svare på denne undersøkelsen!

Klikk neste for å delta.

A.4. Survey: closed and open questions used for this research

CLOSED QUESTIONS

Place belonging

Here we want to know a little more about your belonging to the local community, the people, nature and landscape in the municipality. Decide on the claims below (disagree – disagree some – neutral – agree some - agree)

1. I feel included and involved in the local community where I live
2. The landscape and nature in the municipality mean a lot to my identity
3. I am engaged in the development of the municipality
4. I wish to live in the municipality in the future
5. It doesn't matter much to me where I live, and I might as well live somewhere else
6. I can be myself fully in my municipality
7. I find that it is easy for me to be honest and say what I think about the sustainable development of my municipality

Viable local communities

Here we want to know more about what you think is important for creating a viable and good local community.

In order to contribute to creating a viable and good local community, it is important for me to... (Important – a bit important – a bit unimportant – unimportant)

8. Be attentively present for other people around me
9. Be engaged in local organizations and participate in voluntary work
10. Be engaged in the local politics through political parties
11. Use the opportunities to participate in municipal processes (e.g., in public meetings)
12. Vote in local elections
13. Contribute to creating services that would otherwise be missing at the place

Below are a number of claims that you must decide on. There are no right or wrong answers. It is your personal opinion that counts. (disagree – disagree some – neutral – agree some - agree)

14. We must focus on densification of the townships rather than scattered settlements
15. If we do not get the population to grow, our local community will die out in the future
16. Immigration from other countries is positive for the municipality
17. There is too much talk about increasing the population, and those who already live here are forgotten
18. Good health and quality of life should be a measure of social development, in the same way as GDP (gross domestic product)
19. Social challenges are "drowned" in the focus on climate and environmental problems
20. The municipality should purchase goods and services from local providers

Nature and climate

Below are a number of claims that you must decide on. There are no right or wrong answers. It is your personal opinion that counts (disagree – disagree some – neutral – agree some - agree)**:**

21. Climate change creates challenges in my local community
22. There is an exaggerated focus on climate and the environment
23. Sustainable development entails that we must be willing to change our way of life
24. We must take better care of nature because it forms the basis of our lives
25. Technological development will be able to solve most environmental challenges
26. Nature has a value in itself, and we have an ethical responsibility to take good care of nature

Forest – claims (disagree – disagree some – neutral – agree some - agree)

27. Forest in my municipality means a lot to me
28. I get to actively participate in decisions regarding forest in my municipality
29. Forest encroachment is the greatest problem related to the forest in my municipality
30. We should have a much more active forestry in the municipality
31. There is currently too little conservation of forest in the municipality

Economic value creation

Below are a number of claims that you must decide on. There are no right or wrong answers. It is your personal opinion that counts. (disagree – disagree some – neutral – agree some - agree)

32. I feel that I get to influence the type of business and economic value creation we have in the municipality
33. It is a problem that businesses in the municipality meets too many climate and environmental requirements
34. We should better facilitate for new, green businesses
35. The economic value creation should stay in the rural municipalities, where the natural resources are found
36. The business community in my municipality is driving a more sustainable development
37. Conservation of nature contributes positively to business developments and provides increased value creation
38. Continued economic growth is a precondition for me to live with good quality of life

OPEN QUESTIONS

i) Do you have other thoughts on the importance on forest for you and your local community

ii) What does the concept of sustainable development entail for you?

iii) What type of livelihoods do you think the municipality should focus on in the future?

A.5. Invitation to expert workshop on forest ecosystem services in Norway

Norges miljø- og biovitenskapelige universitet

NINA Norsk institutt for naturforskning

Invitasjon til forskarverkstad

- **vurdering av skogøkosystem og skogøkosystemtenester i Noreg: trendar, tilstand og endringsdrivarar**

Velkommen til digital forskarverkstad torsdag 27. mai, kl. 12:00–14:00, på Zoom

Målet med verkstaden er å samanstille ekspertkunnskap om trendar, tilstand og endringsdrivarar knytt til skogøkosystem og skogen sine bidrag til menneske og samfunn i Noreg i perioden 1950–2020.

Verkstaden vert arrangert som ein del av det tverrfaglege forskingsprosjektet "Real-world ecosystem management; Identifying knowledge gaps and overcoming societal barriers", (ECOREAL). ECOREAL er leia av NINA, og skal kartlegge institusjonelle, sosiale, juridiske og økonomiske barrierar som gjer det vanskeleg å forvalta skogen i Noreg på økosystemnivå.

Vi gjer mellom anna ei vurdering av trendar, tilstand og endringsdrivarar knytt til skogøkosystem i perioden 1950–2020. Her kartlegg vi korleis det norske samfunnet sin bruk av forsynande, kulturelle, regulerande og støttande økosystemtenester frå skog har endra seg, korleis tilstanden er i dag, og kva som har vert dei viktigaste endringsdrivarane gjennom dei siste 70 åra. Noko av kunnskapen som er naudsynt for å gjere desse vurderingane er tilgjengeleg gjennom litteratur og tidlegare forsking. Samstundes er det behov for kunnskapssamanstilling, særleg for å identifisere trendar og dei viktigaste endringsdrivarane. Gjennom denne forskarverkstaden ynskjer vi difor å **samanstille kunnskap frå forskarar innanfor ulike område av norske skogøkosystem.**

Etter ein kort presentasjon av funn i arbeidet så langt, vil den digitale verkstaden veksle mellom arbeid i grupper og drøfting i plenum. I første del av verkstaden vil vi vurdere trendar og tilstand, medan andre del vil handle om å identifisere dei viktigaste endringsdrivarane. Verkstaden vil vere tilrettelagt for å fange opp innspel frå deltakarane undervegs. Innspel frå vurderingar og drøftingar i verkstaden vil bli **samanfatta i ein kort rapport,** som vert delt med alle deltakarane i etterkant.

Vi håpar det vil vere interessant for deg å delta på forskarverkstaden! **Gi tilbakemelding på om du ynskjer å delta til** elisabeth.veivag.helseth@nmbu.no **, tlf: 92284041, innan fredag 30. april.**

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