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CARROTS AND STICKS

Economic mechanisms for safeguarding and financing biodiversity and ecosystem services

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Carrots and Sticks – Economic mechanisms for safeguarding and financing biodiversity and ecosystem services

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Foreword

Our economy is entirely dependent on natural capital: the stock of Earth's natural resources that include geology, soil, air, water and all living things. Natural capital is the fundamental asset that we depend on when accumulating all our other forms of wealth. However, as emphasised by the groundbreaking Dasgupta review, we, as humanity, have been poor asset managers, consuming our natural capital beyond its capacity to regenerate. In doing so, we have undermined the foundations of both our economy and our future.

One reason for this short-sightedness is that we have failed to internalise the economic significance of nature. Natural capital is not sufficiently taken into account by governments, municipalities and businesses. For example, we seldom have to pay for the damage we cause to nature, nor do we assign reward for sustaining the many vital services nature provides us.

In other words, our current economic system does not provide incentives to maintain and increase our natural capital. On the contrary, quite often the opposite is true: degrading nature might be the cheapest option. This dynamic needs to change. We must transform the markets to incentivise investing back in nature. Economic instruments, such as taxes, fees and subsidies, play a key role in succeeding in this.

Finland has a long tradition of pricing carbon emissions. The EU has been a forerunner in developing an efficient carbon trading scheme, the EU ETS. We must now continue this work by also putting a price on the other key pressures we put on nature's vital life-support systems. This report provides examples of how pricing mechanisms related to land use can be used to maintain ecosystem services and reduce adverse impacts on nature. The topic is of the greatest urgency. Later this year countries will gather at the UN Biodiversity Summit in Cali, Colombia, to discuss the national plans to implement the recently adopted Kunming-Montreal global goal for nature – to stop nature loss by 2030 and get nature on track to recovery. There is a global need for scalable policy instruments that must be addressed.

Healthy nature and functioning ecosystems safeguard our health, economy and well-being. We hope that this report provides inspiration for governments, municipalities and companies to put in place efficient measures to start managing our natural capital, as diligent asset managers should.

Helsinki, 4 June 2024.

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Summary

Biodiversity loss is a critical global issue that threatens the function and resilience of ecosystems. Our society and economy are heavily dependent on functioning global ecosystems and the many, varied ecosystem services that they provide. Like many environmental issues, a lack of recognised market value for biodiversity and incentives for protecting ecosystem services has exacerbated their loss.

Without a robust and resilient nature there is no economy. Realising this, public and private institutions around the world are rapidly developing frameworks and tools to address biodiversity loss. This study is a collection of 17 examples where economic mechanisms have been applied with the goal of limiting biodiversity loss associated with land-use change and promoting nature-positive activities. The cases are diverse, including both mandatory and voluntary mechanisms and schemes led by those in the public and private sectors. The cases have been characterised into three main groups: the polluter pays principle; payments for ecosystem services; and voluntary solutions in the private sector.

The polluter pays principle (PPP) schemes are government-led initiatives that set a fee on causing environmental damage. When used to limit biodiversity loss, PPP schemes set a disincentive on economic activities that drive biodiversity loss and often use the fees to incentivise nature-positive activities. As those causing environmental harm internalise the costs of biodiversity loss, PPP schemes can be cost-efficient for regulators to implement and can help to stimulate new markets for nature-positive activities. Important elements of PPP schemes include developing robust methods to quantify, monitor and verify environmental impacts as well as maintaining additionality and permanence of compensatory actions.

Payments for ecosystem services (PES) are voluntary payments made to those enabling the provision of one or many ecosystem services. Within PES schemes, companies and landowners are incentivised to modify their existing activities or undertake new actions to satisfy set criteria and qualify for payments. PES schemes are flexible and have potential to be scaled to new areas, ecosystems and sectors. PES schemes can also help to promote positive attitudes of private landowners towards nature-positive activities. PES schemes are typically led and funded by governments but can also be led or funded by NGOs or the private sector. Important elements of PES schemes include establishing cost-efficient payments, trust between businesses, landowners and governments and the long-term security of public funding.

Voluntary solutions in the private sector represent cases that have been established without government leadership. These schemes can include certification systems that businesses can join, incentives set within a company's supply chain to promote biodiversity-friendly activities or voluntary compensation for land-use change. Implementing a voluntary scheme can help businesses show leadership and target biodiversity impacts associated with their activities. For private-sector schemes, important elements include establishing robust third-party verification of outcomes and alignment with national biodiversity strategies and action plans.

This study also examined cases that fall into an "other" category. These included schemes initiated at the municipal level and mechanisms used within the insurance sector. These cases demonstrate that municipalities can adopt local measures to respond to local drivers of biodiversity and that insurance is a sector that can be used to share the costs of maintaining ecosystems and restoring them.

Expanding the use of economic instruments is crucial to reversing biodiversity decline and there are good examples of these instruments to guide future design. Well-designed schemes

establish the relevant financial incentives to enhance biodiversity and avoid its loss. The role of government is fundamental to establishing mandatory or publicly funded schemes, and can be faciliatory in many private sector-led initiatives. Publicly funded mechanisms will not be able to solely address the biodiversity crisis, therefore providing the appropriate environment for private-sector initiatives to help achieve local biodiversity targets is important. This can be supported by strong dialogue and co-operation between the scientific and business communities and regulators.

Developing successful economic mechanisms takes time and often requires a pilot phase to ensure that the set incentives are effective and appropriate. Assessing the effectiveness and appropriateness of a scheme calls for standardised third-party evaluations that include monitoring of ecological outcomes. Well-designed mechanisms can also stimulate new markets for expert service providers and green job creation.

The long-term success and acceptance of economic mechanisms hinges on how well stakeholders are trained, engaged and experience positive socio-economic benefits from the scheme. To achieve this, economic mechanisms addressing biodiversity loss should also seek to promote local economies and cultural values. When local communities share in the benefits created by economic mechanisms, their motivation to actively participate increases.

Biodiversity loss is a critical challenge that requires urgent action to be halted; however it is imperative to also recognise the close linkages between other environmental values such as climate, water and soil. Designing economic instruments that target multiple environmental issues is often the efficient and necessary choice. New initiatives targeting biodiversity should be developed with consideration for how they interact with existing environmental incentives and any potential synergies.

In Finland, several mechanisms (such as PES and voluntary compensation) are already in place. There is potential to increase the usage of economic mechanisms to help set the appropriate incentives for reaching national and local biodiversity-related targets. New economic mechanisms could be designed to address the most important local drivers of biodiversity loss. The development of new instruments should involve an evaluation of the implications and their feasibility before implementation.

Tiivistelmä

Luonnon monimuotoisuuden maailmanlaajuinen köyhtyminen heikentää ekosysteemien toimintaa ja palautumiskykyä (resilienssiä). Yhteiskuntamme ja taloutemme ovat riippuvaisia ekosysteemien toiminnasta ja niiden tarjoamista monista erilaisista ekosysteemipalveluista. Markkinahintojen ja kannusteiden puuttuminen on kiihdyttänyt luonnon monimuotoisuuden ja ekosysteemipalveluiden heikentymistä, kuten myös muita ympäristöongelmia.

Ilman toimivaa ja palautumiskykyistä luontoa ei ole taloutta. Tästä syystä julkiset ja yksityiset instituutiot ympäri maailmaa kehittävät viitekehyksiä ja työkaluja luonnon monimuotoisuuden turvaamiseksi. Tämä selvitys kokoaa yhteen 17 tapaustutkimusta, joissa taloudellisia mekanismeja, kuten julkisen vallan asettamia maksuja ja tukia tai yritysten vapaaehtoisia ratkaisuja, on otettu käyttöön maankäytön muutoksiin liittyvän luonnon monimuotoisuuden heikkenemisen rajoittamiseksi sekä luontopositiivisten toimien kannustamiseksi. Esimerkit ovat keskenään erilaisia: mukana on sekä pakollisia että vapaaehtoisia ohjelmia, joita johdetaan valtion tai yksityisen sektorin toimesta. Esimerkit on jaoteltu kolmeen pääryhmään: saastuttaja maksaa -periaate (polluter pays), tuet ekosysteemipalveluiden vahvistamiseen (payments for ecosystem services) ja yritysten vapaaehtoiset ratkaisut.

Saastuttaja maksaa -periaatteen mukaisissa mekanismeissa tyypillisesti valtio asettaa maksun, joka on maksettava vahingon aiheuttamisesta luonnolle. Kun mekanismia käytetään luonnon monimuotoisuuden heikkenemisen torjumiseen, luontokatoa aiheuttavaa taloudellista toimintaa sakotetaan – ja usein kerätyt rahat ohjataan luontoa vahvistaviin toimiin. Kun luonnolle vahinkoa aiheuttavat toimijat joutuvat ottamaan huomioon luonnon heikentämisestä seuraavan kustannuksen, saastuttaja maksaa -periaatteen mukaiset mekanismit voivat olla lainsäätäjälle kustannustehokkaita toteuttaa ja ne voivat auttaa stimuloimaan uusia markkinoita luontopositiivisille toimille. Tärkeitä elementtejä ovat luotettavien menetelmien kehittäminen ympäristövaikutusten kvantifiointiin, monitorointiin ja todentamiseen sekä hyötyjä tuottavien toimien lisäisyyden ja pysyvyyden varmistaminen.

Tukia ekosysteemipalveluiden vahvistamiseen (PES) maksetaan toimijoille, kuten maanomistajille, mahdollistamaan yhden tai useamman ekosysteemipalvelun tarjontaa. Tällaiset mekanismit kannustavat muuttamaan nykyistä toimintaa tai toteuttamaan uusia toimia, joiden myötä maksujen ehtoina olevat kriteerit täyttyvät. Mekanismit ovat joustavia ja niitä voidaan skaalata uusille alueille, ekosysteemeihin ja sektoreihin. Mekanismit voivat myös auttaa vahvistamaan yksityisten maanomistajien myönteistä suhtautumista luontoa hyödyttäviä toimia kohtaan. Tyypillisesti ohjelmat ovat valtiovetoisia ja -rahoitteisia, mutta niitä voivat pyörittää ja rahoittaa myös ei-valtiolliset toimijat, kuten kansalaisjärjestöt tai yritykset. Tärkeitä elementtejä ovat kustannustehokkuus, luottamus osapuolten välillä, tulosten todentaminen ja rahoituksen pitkäjänteisyys.

Yritysten vapaaehtoiset ratkaisut on otettu käyttöön ilman valtion johtavaa roolia. Tällaisia ratkaisuja ovat esimerkiksi sertifikaatit, joihin yritykset voivat liittyä, kannusteet arvoketjun sisällä luontoystävällisten toimien edistämiseksi tai vapaaehtoinen maankäytön muutoksen kompensointi. Vapaaehtoisen ratkaisun käyttöönotto voi auttaa yrityksiä toimimaan edelläkävijänä ja se voi auttaa hillitsemään vaikutuksia, jotka ovat niiden toiminnan kannalta olennaisimpia. Vapaaehtoisissa ratkaisuissa tärkeitä elementtejä ovat kolmannen osapuolen toteuttama luotettava tulosten todentaminen sekä yhteydet kansallisiin biodiversiteettistrategioihin ja toimintaohjelmiin.

Osa kerätyistä esimerkeistä sijoitettiin ‘Muut’-kategoriaan, kuten esimerkiksi kunnallisen tason ohjelmat ja vakuutusalan hyödyntämät mekanismit. Esimerkit osoittavat, että kunnat voivat toteuttaa toimia paikallisiin luontokadon ajureihin vastaamiseksi, ja vakuuttaminen on toimiala, jota voidaan hyödyntää ekosysteemien kunnostamiseen liittyvien kustannusten jakamiseen.

Taloudellisten mekanismien nykyistä laajempi hyödyntäminen on tärkeää luontokadon pysäyttämiseksi, ja hyviä esimerkkejä on saatavilla uusien mekanismien suunnittelun tueksi. Kun mekanismit on suunniteltu hyvin, ne tarjoavat relevantit rahalliset kannusteet luonnon vahvistamiseen ja luontohaittojen välttämiseen. Valtion rooli on keskeinen pakollisissa ja julkisia rahoja hyödyntävissä mekanismeissa, ja sillä on myös mahdollistava rooli monissa yksityisen sektorin ohjelmissa. Julkisesti rahoitetut mekanismit eivät yksin riitä luontokadon pysäyttämiseen. Siksi on tärkeää tarjota oikeanlainen toimintaympäristö yksityisen sektorin aloitteille, jotta ne voivat auttaa luontotavoitteiden saavuttamisessa. Tätä voidaan tukea aktiivisella dialogilla ja yhteistyöllä tiedeyhteisön, yritysten ja lainsäätäjien välillä.

Toimivien taloudellisten mekanismien kehittäminen vie aikaa ja vaatii usein pilottivaiheen, jotta varmistetaan kannusteiden tehokkuus ja tarkoituksenmukaisuus. Tehokkuuden ja tarkoituksenmukaisuuden arviointi edellyttää standardoitua ulkopuolisen tahon selvitystä, joka sisältää ekologisten vaikutusten seurannan. Hyvin suunnitellut mekanismit voivat myös synnyttää uusia markkinoita asiantuntijapalveluille ja luoda vihreitä työpaikkoja.

Taloudellisten mekanismien pitkän tähtäimen menestys ja hyväksyttävyys riippuvat siitä, kuinka hyvin sidosryhmille on tarjottu koulutusta, kuinka heitä on osallistettu sekä millaisena he näkevät mekanismin sosio-ekonomiset vaikutukset. Siksi luontokatoa torjuvien mekanismien tulisi myös pyrkiä edistämään aluetaloutta ja kulttuuriarvoja. Kun paikalliset yhteisöt pääsevät osallisiksi taloudellisten mekanismien hyödyistä, niiden motivaatio aktiiviseen osallistumiseen kasvaa.

Luontokadon pysäyttäminen edellyttää välittömiä toimia. Samalla on välttämätöntä tunnistaa myös muiden ympäristöteemojen, kuten ilmaston, veden ja maaperän, väliset läheiset yhteydet. Usein tehokasta ja tarpeellista on suunnitella useita ympäristökysymyksiä huomioiva mekanismi. Kun suunnitellaan uusia luontokatoa torjuvia mekanismeja, tulee huomioida, kuinka ne ovat vuorovaikutuksessa jo käytössä olevien mekanismien kanssa, ja niiden mahdolliset synergiat.

Suomessa on jo käytössä useita mekanismeja, kuten tuet ekosysteemipalveluiden vahvistamiseen ja vapaaehtoinen ekologinen kompensaatio. Taloudellisia mekanismeja voitaisiin hyödyntää nykyistä enemmän tarkoituksenmukaisten kannustimien asettamiseksi, jotta kansalliset ja alueelliset luonnon monimuotoisuuteen liittyvät tavoitteet saavutettaisiin. Uusia ohjauskeinoja voitaisiin suunnitella tärkeimpiin alueellisiin luontokadon ajureihin vaikuttamiseksi. Uusia ohjauskeinoja kehitettäessä tulee arvioida vaikutuksia ja toteutettavuutta ennen käytännön toteutusta.

Sammanfattning

Förlusten av biologisk mångfald är ett allvarligt globalt problem som hotar ekosystemens rikedom och motståndskraft. Vårt samhälle och vår ekonomi är starkt beroende av fungerande globala ekosystem och de många och varierande ekosystemtjänster som de tillhandahåller. Liksom många andra miljöfrågor har bristen på erkänt marknadsvärde för biologisk mångfald och incitament för att skydda ekosystemtjänster förvärrat förlusten av dem.

Utan en robust och motståndskraftig natur finns det ingen ekonomi. Offentliga och privata institutioner runt om i världen inser detta och utvecklar snabbt ramar och verktyg för att ta itu med förlusten av biologisk mångfald. Denna studie är en samling av 17 exempel där ekonomiska mekanismer har tillämpats med målet att begränsa förlusten av biologisk mångfald i samband med förändrad markanvändning och främjande av naturpositiva aktiviteter. Exemplenen är av olika slag och omfattar både obligatoriska och frivilliga mekanismer och system som leds av aktörer från både den offentliga och den privata sektorn. Exemplen har delats in i tre huvudgrupper: principen om att förorenaren betalar, ersättning för ekosystemtjänster och frivilliga lösningar inom den privata sektorn.

Principen om att förorenaren betalar (PPP) är statligt ledda initiativ som fastställer en avgift för miljöskador som orsakas av en ekonomisk aktör. När offentlig-privat samverkan används för att begränsa förlusten av biologisk mångfald avskräcker de från ekonomisk verksamhet som driver på förlusten av biologisk mångfald, till förmån för naturpositiva verksamheter istället. Eftersom den ekonomiska aktör som orsakar miljöskador internaliserar kostnaderna för förlusten av biologisk mångfald kan offentlig-privata samverkanssystem vara kostnadseffektiva för tillsynsmyndigheterna att genomföra och bidra till att stimulera nya marknader för naturpositiv verksamhet. Viktiga inslag i offentlig-privata samverkansprogram är bland annat att utveckla robusta metoder för att kvantifiera, övervaka och verifiera miljöpåverkan samt att upprätthålla kompensationsåtgärdernas additionalitet (att insatsen inte hade kunnat genomföras utan åtgärden) och varaktighet.

Betalningar för ekosystemtjänster är frivilliga betalningar till en ekonomisk aktör som gör det möjligt att tillhandahålla en eller flera ekosystemtjänster. Inom de offentliga arbetsförmedlingarna uppmuntras de ekonomiska aktörerna att ändra sin befintliga verksamhet eller vidta nya åtgärder för att uppfylla fastställda kriterier och berättiga till stöd. De offentliga arbetsförmedlingarna är flexibla och har potential att utvidgas till nya områden, ekosystem och sektorer. De offentliga arbetsförmedlingarna kan också bidra till att främja privata markägares positiva attityder till naturpositiva aktiviteter. De offentliga arbetsförmedlingarna leds och finansieras vanligtvis av staten, men kan också ledas eller finansieras av icke-statliga organisationer eller den privata sektorn. Viktiga inslag i de offentliga arbetsförmedlingarnas system är bland annat att fastställa kostnadseffektiva betalningar, förtroende mellan aktörer och långsiktighet, kontroll av resultat och säkerhet i fråga om offentlig finansiering.

Frivilliga lösningar inom den privata sektorn avser exempel som har etablerats utan statlig ledning. Dessa system kan omfatta certifieringssystem som företag kan ansluta sig till, incitament inom ett företags leveranskedja för att främja verksamhet som främjar biologisk mångfald eller frivillig kompensation för förändrad markanvändning. Att genomföra ett frivilligt system kan hjälpa företag att visa ledarskap jämfört med konkurrenterna och därtill att försöka rikta in sig på de effekter som är mest relevanta för deras verksamhet. När det gäller program inom den privata sektorn är det viktigt att inrätta en robust tredjepartskontroll av

resultaten och att anpassa dem till nationella strategier och handlingsplaner för biologisk mångfald.

Studien innehöll också exempel som placerades i kategorin "Övrigt". Det rörde sig bland annat om system som initierats på kommunal nivå och mekanismer som används inom försäkringssektorn. De viktigaste slutsatserna är att kommuner kan vidta lokala åtgärder för att bemöta lokala drivkrafter för biologisk mångfald och att försäkringar är en sektor som kan användas för att dela på kostnaderna och fördelarna med ekosystemtjänster när de används för att minska riskexponeringen.

Att öka användningen av ekonomiska styrmedel är avgörande för att minska och vända förlusten av biologisk mångfald, och det finns goda exempel på dessa styrmedel som kan vägleda den framtida utformningen. Väl utformade system skapar relevanta ekonomiska incitament för att stärka den biologiska mångfalden och undvika att den går förlorad. Statens roll är grundläggande när det gäller att inrätta obligatoriska eller offentligt finansierade system, och underlättande i många initiativ som leds av den privata sektorn. Offentligt finansierade mekanismer kommer inte att kunna hantera krisen för den biologiska mångfalden på egen hand, och därför är det viktigt att skapa en lämplig miljö för initiativ från den privata sektorn för att bidra till att uppnå målen för biologisk mångfald. Detta kan stödjas genom en stark dialog och ett starkt samarbete mellan forskarvärlden, näringslivet och tillsynsmyndigheterna.

Att utveckla framgångsrika ekonomiska mekanismer tar tid och kräver ofta pilotfaser för att säkerställa att de fastställda incitamenten är effektiva och lämpliga. Att bedöma effektiviteten och lämpligheten av ett system kräver standardiserade tredjepartsutvärderingar som inkluderar övervakning av ekologiska resultat. Väl utformade mekanismer kan också stimulera nya marknader för experttjänsteleverantörer och skapande av gröna jobb.

Den långsiktiga framgången och acceptansen för ekonomiska mekanismer beror på hur väl berörda parter är utbildade, engagerade och upplever positiva socioekonomiska fördelar av systemet. För att uppnå detta bör ekonomiska mekanismer för att ta itu med förlusten av biologisk mångfald också sträva efter att främja lokala ekonomier och kulturella värden. När lokalsamhället får del av de fördelar som skapas av de ekonomiska mekanismerna ökar deras motivation att delta aktivt.

Förlusten av biologisk mångfald är en kritisk utmaning som kräver omedelbara åtgärder för att stoppas, men det är absolut nödvändigt att också ta i beaktande de nära kopplingarna mellan andra miljövärden som klimat, vatten och mark. Att utforma ekonomiska styrmedel som riktar sig mot flera miljöfrågor är ofta ett effektivt och i förlängningen ett nödvändigt val. Nya initiativ som är inriktade på biologisk mångfald bör utvecklas med hänsyn till hur de samverkar med befintliga miljöincitament och eventuella synergier som utnyttjas.

I Finland finns redan flera mekanismer (t.ex. ersättning för ekosystemtjänster och frivillig kompensation). Det finns potential att öka användningen av ekonomiska mekanismer för att skapa lämpliga incitament för att nå nationella och lokala mål för biologisk mångfald. Nya ekonomiska instrument skulle kunna utformas för att ta itu med de viktigaste regionala drivkrafterna bakom förlusten av biologisk mångfald. Utvecklingen av nya instrument bör omfatta en utvärdering av konsekvenser och genomförbarhet innan de genomförs.

1. The urgent need to harness economic mechanisms for biodiversity and ecosystem services

Biodiversity and numerous ecosystem services are often undervalued and hence underfunded and undersupplied, primarily because of various market failures. A range of economic mechanisms, including the polluter pays principle, payments for ecosystem services and various voluntary measures within the private sector, have been devised to address this issue. This report serves as an illustrative showcase of different mechanisms, providing examples of their successful use in various regions and ecosystems.

1.1. Biodiversity is in crisis – is pricing the solution?

Biodiversity is acknowledged to be fundamental to human well-being, and yet it is declining faster than at any time in human history. The Intergovernmental Panel on Climate Change (IPCC) and the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES) in a joint report state that over the last 150 years, increased energy use, excessive use of natural resources and major changes to land, water and oceans have led to climate change and a rapid decline in biodiversity. Current policies usually deal with these issues separately, but the report suggests that addressing both biodiversity loss and climate change together, while considering their societal impacts, can bring multiple benefits and help achieve development goals for everyone (IPBES 2021).

Biodiversity loss can, at least to some extent, be explained by market failures. Biodiversity and many regulating or supporting ecosystem services are public goods and/or externalities. Public goods are non-rivalrous (use of the service does not prevent others from enjoying it) and non-excludable (others cannot be excluded from enjoying the benefits). For example, biodiverse ecosystems can provide natural filtration and purification of water through processes such as nutrient cycling, sediment trapping and microbial activity. Wetlands, riparian zones and mangrove forests, for example, help to remove pollutants, excess nutrients and sediment from water bodies, improving water quality and supporting aquatic ecosystems. Externalities arise when the production or consumption of a good or service imposes a cost or benefit on third parties not involved in the transaction. For example, clearing of land, such as forest, may negatively affect water regulation services and therefore increase flood damage costs for third parties. On the other hand, forests provide many environmental, health and recreational benefits for people who do not contribute to their management costs. Because of these market failures, biodiversity and ecosystem services are often undervalued, undersupplied and underfunded.

Market failures in biodiversity are compounded by the lack of well-defined property

rights of environmental goods and services, and as a result, no one has a financial interest in, or can derive direct financial benefit from, conserving them or ensuring that they are allocated to their highest-value use (Deutz et al. 2020; Barbier 2022).

The financial flows required to address biodiversity loss have been estimated to be US$720–970 billion per year. When compared with present financing levels, the current estimated gap is around US$600–820 billion annually (Deutz et al. 2020) (2019-level US$). The Organisation for Economic Co-operation and Development (OECD 2020) estimated that the average global biodiversity finance level was equivalent to about 0.1% of global GDP in the period 2015-2017. There is a widely shared view that funding for biodiversity protection should be increased (Deutz et al. 2020).

The World Economic Forum estimates that about half, US$44 trillion, of the global Gross Domestic Product (GDP) is highly or moderately dependent on nature (WEF 2020). Besides public funding, there is a need to engage and incentivise the private sector with new economic instruments to halt biodiversity loss and to ensure external biodiversity benefits by mobilising financial flows towards biodiversity-positive activities and biodiversity protection. There is an important role for governments for putting in place suitable regulatory environments, incentives and market structures to catalyse financial flows from the private sector into addressing biodiversity loss.

In December 2022, the key global biodiversity platform, in its 15th Conference of the UN Convention on Biological Diversity, adopted the "Kunming-Montreal Global Biodiversity Framework" (GBF), including four goals and 23 targets for achievement by 2030. One of the goals is:

> **BIODIVERSITY** is sustainably used and managed and nature's contributions to people, including ecosystem functions and services, are valued, maintained and enhanced, with those currently in decline being restored, supporting the achievement of sustainable development, for the benefit of present and future generations by 2050.

Target 19 tackles the challenge by urging countries to

> **SUBSTANTIALLY** and progressively increase the level of financial resources from all sources, in an effective, timely and easily accessible manner, including domestic, international, public and private resources … to implement national biodiversity strategies and action plans (Kunming-Montreal, Global Biodiversity Framework, 2022).

The global targets of the GBF are adapted to national biodiversity strategies and action plans (NBSAPs), and to even more detailed sub-national action plans. These co-ordinated biodiversity strategies and action plans aim to set a conceptual framework for nature, including measurable indicators, as well as provide agreed and understood key concepts of biodiversity. It is essential to ensure the alignment of private-sector initiatives with the priorities outlined in national and sub-national biodiversity policies to strengthen the implementation of GBF.

The European Union institutions are at the forefront of stimulating EU member states to establish pioneering practices and promote economic mechanisms that reward nature markets' pioneers. To this aim, the EU has a leading role in creating an ambitious global framework for 2030, in line with the Kunming-Montreal GBF. Besides the EU Biodiversity Strategy 2030, biodiversity loss is aligned with a variety of EU policy instruments. The European Green Deal seeks to impact economic decision-making to benefit nature, for example via the EU Taxonomy and the Corporate Sustainability Reporting

Directive (CSRD) or the Nature Restoration Law, which proposes setting binding targets to stop biodiversity loss by establishing restoration measures on at least 20% of all EU land and sea areas by 2030. These policy initiatives increase opportunities for the introduction of new economic instruments.

1.2. Why does biodiversity loss matter

The conceptual framework of the Intergovernmental Science-Policy Platform for Biodiversity and Ecosystem Services (IPBES) describes nature as: "The natural world with an emphasis on the diversity of living organisms and their interactions among themselves and with their environment" (Díaz et al. 2015). This includes not only living (biotic) and non-living (abiotic) parts of the natural environment but also biodiversity and climate. This is also referred to as natural capital, or some part of it as natural resources, the term natural capital emphasising its capital asset feature, like produced capital (roads and buildings) and human capital (knowledge and skills) (Dasgupta 2021).

Ecosystems (for example forests) are constituted by these living and non-living parts, providing ecosystem services, crucially important to our well-being and health and human economic activity. The ability of nature to provide these ecosystem services like pollination services and water provision services depends on biodiversity. Biodiversity refers to variability among living organisms, which includes the diversity within species, between species, habitats and ecosystems. This variability is critical for the resilience, adaptability and productiveness of ecosystems. Biodiversity should therefore be understood as a characteristic of healthy ecosystems (Network for Greening the Financial System 2023). Besides habitats and species, the key elements are structure and function of habitats, which play a crucial role in setting a price for nature. There are different kinds of classification systems of habitats used at regional (EU) and national levels.

According to the first global assessment report on biodiversity and ecosystem services, the main global drivers of nature degradation are in an order of their impact: (i) changes in land and sea use; (ii) overexploitation (extraction of living and non-living materials); (iii) climate change; (iv) pollution; and (v) invasive alien species. These direct drivers are in turn underpinned by societal values and behaviours that include production and consumption patterns, human population dynamics and trends, trade, technological innovations and local and global governance (IPBES 2019). To respond simultaneously to these environmental challenges, both climate change and biodiversity loss, measures should be taken to protect, conserve, restore and sustainably use and manage ecosystems.

The economic and financial risks related to the degradation of nature, either due to physical (decline of ecosystem services) or transition risks (misalignment with policy aimed at protecting, restoring and reducing negative impacts on nature), are becoming increasingly relevant. This is due to the lack of action to reduce the negative impacts of human activities on nature or to enhance the health of ecosystems.

A myriad of voluntary or mandatory cases that use economic mechanisms proves that there is a wide-ranging inclination to change behaviour and to increase financing to close the funding gap of biodiversity loss (European Investment Bank 2023). However, monetary valuation of nature alone will not solve the biodiversity loss crisis. The main reasons are, among others, that the set monetary values often end up misrepresenting the full value of nature and that the participation of indigenous peoples and local communities is overlooked (IPBES 2022).

The mitigation hierarchy

The mitigation hierarchy is a widely used tool to limit physical risks and to reduce negative impacts on nature. It consists of the following five steps and outcomes (adapted from Arlidge et al. (2018) and Cares et al. (2023)). The mitigation hierarchy is used in this report to help characterise the mitigation steps each case study is seeking to promote.

- **AVOIDANCE:** prevent negative impacts from occurring; for example, through land-use planning.
- **MINIMISATION:** reduce the duration, intensity and/or extent of negative impacts through actions like demand reduction; certification and ecolabelling; economic incentives (market prices, taxes, subsidies and other signals).
- **RESTORATION:** restore or rehabilitate degraded ecosystems, for instance by rewilding, restoring or creating or new habitats.
- **OFFSET:** compensate for any remaining significant adverse impacts through actions like restoring degraded ecosystems away from the impact site, averting risks and removing invasive species.
- **ENHANCEMENT:** apply measures to purposefully increase natural values.

The concept of "net gain" is used to describe an approach to mitigation that targets a scenario where the natural environment in a measurably better state that it was beforehand.

1.3. Objective of the study

This report contributes by providing an insight into the innovation and applicability of different economic instruments targeting biodiversity loss. This is done by describing and assessing a selection of case studies that address terrestrial biodiversity loss or seek to protect ecosystems impacted by land use and land-use change. It is important to note that this report does not try to provide a comprehensive assessment of economic mechanisms. Instead, our purpose is to highlight interesting cases with characteristics that could spark ideas for adoption.

Historically, nature protection has been implemented primarily through management of state-owned land or transferring land to the state's possession, for example by establishing national parks. Depending on the status and strength of landownership, the landowners were compensated for the estimated value of land according to the production potential of the land use. While those responsible for environmental harm were required to obtain licences, the associated fees collected by authorities were often not used for the active preservation of nature. Licensing results in additional costs for harmful activities and avoidance of activities that become unprofitable due to licensing fees or obviously breach licence limits. Historically however, these licences have typically not been used to target biodiversity loss caused by land-use change. The past two decades have seen an upsurge in new mechanisms relying on the willingness of landowners to sell land or otherwise engage in nature protection and enforcement measures to compel those causing harm to the environment to mitigate the consequences of their actions.

To incentivise the integration of natural values into business activities and decision-making processes, public, private and co-financed economic instruments are being developed to avoid, minimise, restore and offset biodiversity loss. However, implementation of such instruments requires modifications to existing regulatory and market structures.

1.4. Economic mechanisms

Cases described in the report represent three key economic mechanisms for funding and supporting the protection and enhancement of biodiversity and ecosystem services.

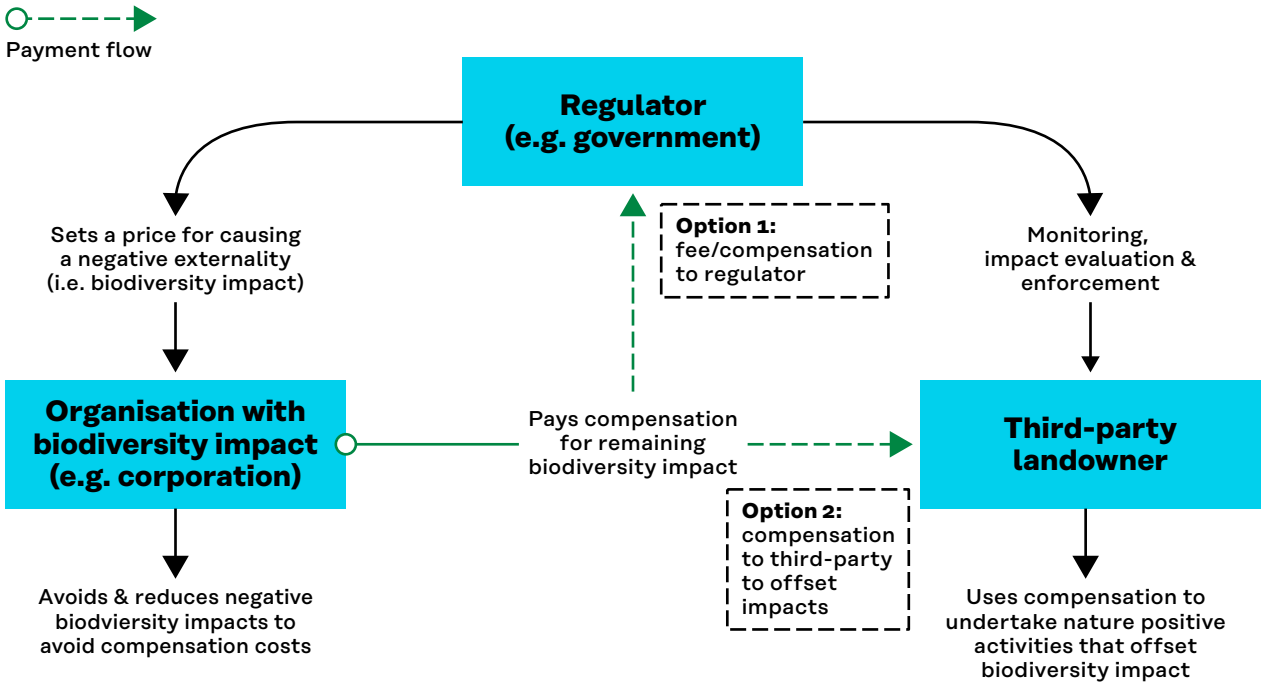
1) Polluter pays principle (PPP)

The polluter pays principle (PPP) approach is one of the key government-regulated principles underlying the European Union's environmental policy. Within a PPP mechanism, a regulator sets a fee associated with environmental harm. Typical examples of PPP mechanisms are environmental taxes or fees levied by the regulator. Another example is a tradable permit scheme, which sets a cap or quota for pollution and only allows pollution within these tradable permits. The objective of this fee is to disincentivise economic activities that are harmful to nature by increasing costs.

In many PPP mechanisms associated with land-use change, the fee or charge is directed to a third-party to fund nature-positive activity. The aim of this type of PPP mechanism – ecological compensation – is to both disincentivise harmful economic activity and incentivise nature-positive activity. The PPP cases contained in this report are all examples of ecological compensation schemes (see Figure 1).

The PPP mechanism originates from economic literature in the 1920s and was adopted by the OECD in 1972 as an economic principle for allocating the costs of pollution control. It has since evolved into a standard in pollution prevention. Over time, the principle has been extended to address various instances of environmental harm, including those affecting biodiversity and ecosystem services. Biodiversity offsets and ecological compensation schemes are increasingly being used as potential methods to offset adverse and unavoidable impacts of projects (IUCN 2023).

Figure 1. Polluter pays principle (PPP)



PPP mechanisms seek to address the market failure associated with biodiversity, as the party responsible for causing environmental harm internalises these external costs. Thus, for public agencies, PPP provides a cost-efficient way to reduce environmental harm. A PPP mechanism is a fee-based mechanism and therefore does not depend on the availability of public funding. As a result, mechanisms can be low-cost for the regulator or help to raise revenue through the collection of the associated fee.

Within a PPP mechanism, those responsible for causing harm or risks to the environment either decide not to go ahead with the project or bear the cost by either deploying additional resources to prevent or minimise harm, or by financing restoration, purchasing credits or implementing other compensatory measures (see Figure 1).

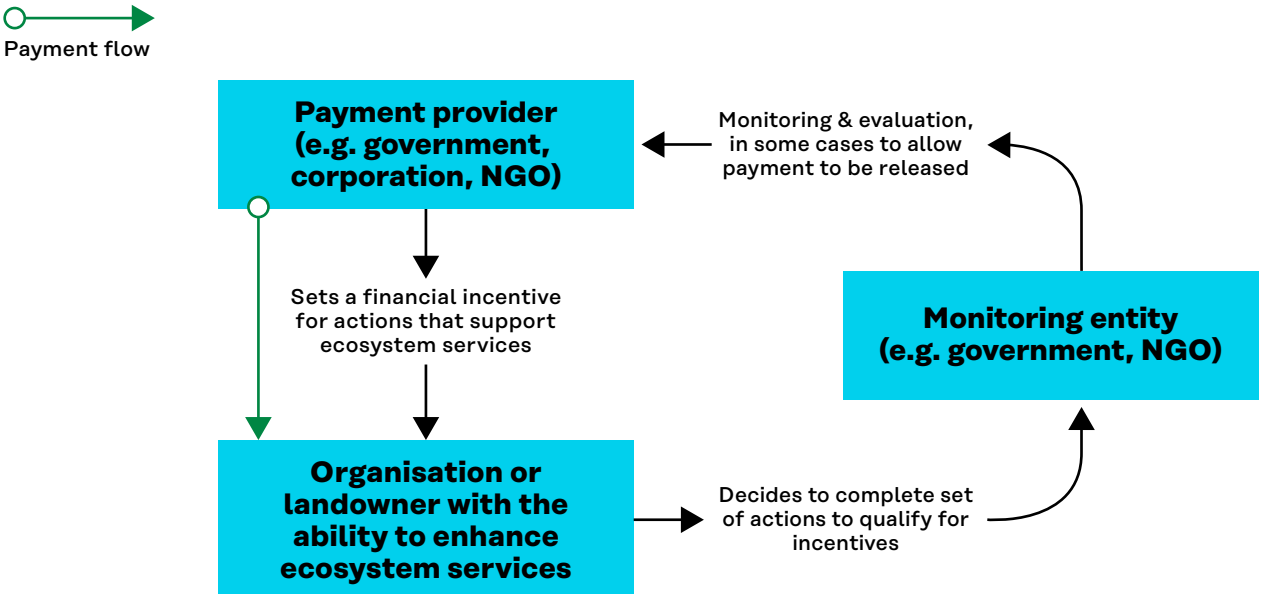
2) Payments for ecosystem services

Payments for ecosystem services (PES) entails mutually voluntary, monetary transactions between a buyer and at least one seller concerning a specific ecosystem service, or land use aimed at securing that service. Thus, it is in accordance with the beneficiary pays principle, where entities, often from the public sector, pay for environmental benefits maintained and enhanced by landowners.

The adoption of the PES approach gained traction in the early 2000s after the Millennium Ecosystem Assessment (MEA) (Millennium Ecosystem Assessment 2005) had underlined the alarming rate of deterioration of ecosystem services and the problem of the lack of economic mechanisms.
PES also has its foundation in economics back in the 1970s – public goods, due to their characteristics, are often externalised in decision-making processes, leading to market failures. Consequently, a market is established to attribute value to these public goods. For example, landowners may not perceive direct benefits from biodiversity or ecosystem services and may not consider the environmental impact of their action. However, when landowners receive payment for specific activities aimed at preserving nature and ecosystem services, they are incentivised to keep doing so. Thus, PES schemes are conceptually market-based instruments, even when employed by public entities.

Designing a PES scheme necessitates a well-established understanding of ecological objectives, the implementation of

Figure 2. Payments for ecosystem services (PES)



cost-efficient pricing mechanisms, fair contracting with landowners, awareness campaigns to engage and inform landowners and the ongoing monitoring and evaluation of compliance and results (Jack et al. 2008).

Typically, PES schemes are government-led payment schemes linked to supporting national policies and/or strategies to promote biodiversity or the environment. Usually, government budgets are allocated to intermediate governmental agencies, who in turn are responsible for implementing the payment scheme, establishing contracts with landowners and monitoring and evaluating the outcomes. In private-sector schemes, beneficiaries of ecosystem services establish contracts directly with service providers. In a mixed scheme of public-private payment, both government and private-sector funding is used (Fripp 2014).

3) Voluntary solutions in the private sector

Voluntary mechanisms within the private sector are typically private-to-private initiatives characterised by minimal governmental intervention. Private-sector firms voluntarily design schemes to mitigate their detrimental impact on nature (for example, adhering to the polluter pays principle) or to enhance the value of nature (such as adhering to a PES or beneficiary pays principle).

Voluntary mechanisms can include impact investments or the integration of biodiversity considerations into product and commodity sales. Impact investments can enhance profitable co-operation between the private, public and third sectors by preventing and solving various well-being and environmental problems (Sitra 2024). They encompass a range of financial instruments, such as blended finance, green bonds, payments for ecosystem services (PES), capital markets solutions and habitat banks. Private entities implement these mechanisms to actively contribute to and invest in biodiversity safeguarding. The reasons behind voluntary action can typically be attributed to a social licence to operate, risk management, or environmental, social and governance (ESG) policy. Voluntary mechanisms may serve as forerunners of forthcoming governmental actions, often leveraging the polluter pays principle (PPP) and/or payments for ecosystem services (PES).

Other mechanisms were also included in this report. These fall into two categories: insurance-based innovations and voluntary mechanisms implemented by municipalities.

1.5. Methodology

For a general overview of the different pricing mechanisms currently in use, we conducted a scan and literature review of various databases. This yielded 62 cases representing a wide range of ecosystems (forest, agricultural areas, wetlands and urban areas) and from locations around the world. For the identification of potential case studies, we used various databases such as the IUCN Database on biodiversity offset policies, OPPLA (EU Repository of Nature-Based Solutions), the Urban Nature Atlas, WAVES (Wealth Accounting and the Valuation of Ecosystem Services), the European Investment Bank's Natural Capital Financing Facility and the Convention on Biological Diversity's case studies database. The objective was to search for innovative examples with interesting characteristics. Many examples were nascent, but there were also some mature, well-documented cases, such as the biodiversity conservation programme METSO in Finland or the New York City Watershed Programme. Despite the intention to present a range of examples, the collected cases still capture only a small portion of the wealth of innovations in mechanisms addressing biodiversity loss. The authors acknowledge that there are numerous other successful cases of economic mechanisms, implemented in various locations, to address nature loss that have not been covered in this report.

The 62 cases were listed in terms of the following categories.

- **COUNTRY AND REGION**
- Ecosystem type:
  - urban
  - forest
  - agriculture
  - wetlands
- **PRICING MECHANISM:**
  - polluter pays principle
  - payments for ecosystem services
  - voluntary solutions in the private sector
  - other
- **TYPE OF PAYMENT:**
  - compensation for lost income
  - cost coverage,
  - payment for value
  - payment for damage
  - purchase of land
- **FLOW OF FUNDING OR OTHER ECONOMIC INSTRUMENT AND BENEFICIARIES:**
  - private to private
  - public to private
  - private to public
- **IDENTIFICATION OF FUNDERS, BENEFICIARIES AND INTERMEDIATE AGENCIES**
- **SCOPE OF ACTION:**
  - local
  - national
  - international
- **POTENTIAL FOR SCALING UP THE MECHANISM:**
  - high
  - medium
  - low
- **WHETHER DATA ON ECOLOGICAL BENEFITS WAS PRESENT**

Based on these categories we then selected 17 examples using the following criteria.

1) **GEOGRAPHICAL AND ECOSYSTEM COVERAGE:** this criterion aims to ensure a wide representation of geographical locations and different ecosystems. Cases were selected to represent different regions, countries or continents as well as forest, agricultural, wetland and urban ecosystems, to capture a broad range of natural values.
2) **COVERAGE OF DIFFERENT MECHANISMS:** this criterion emphasises the inclusion of case studies that represent a variety of mechanisms. It ensures that the shortlist encompasses examples of mechanisms such as the polluter pays principle, payments for ecosystem services, voluntary solutions in the private sector and other relevant mechanisms.
3) **AVAILABILITY OF DATA:** this criterion assesses the availability and accessibility of relevant data and information necessary for conducting a thorough analysis of the case studies. Cases with comprehensive and reliable data were prioritised.
4) **EVALUATION OF ECOLOGICAL BENEFITS:** this criterion assesses whether an environmental impact assessment of the case is available.
5) **POTENTIAL FOR SCALING UP:** this criterion focuses on identifying case studies that demonstrate the potential for scalability and wider application. Cases with the potential to be replicated or expanded to a larger scale were considered favourably.

2. Case studies

The study highlights 17 cases that illustrate mechanisms such as the polluter pays principle, payments for ecosystem services, voluntary initiatives within the private sector, insurance-based innovations and voluntary mechanisms implemented by municipalities. Notably, some of these cases are in the nascent stages of development, and their inclusion is based on their new and interesting characteristics, as well as the future potential of the employed mechanisms.

2.1. Polluter pays principle

2.1.1 Biodiversity net gain (BNG)

Location: UK, Europe

Ecosystem type: multiple

Mitigation hierarchy: avoidance, minimisation, restoration, enhancement, net gain

Key stakeholders
Lead: government
Source of funding: developers, private
Beneficiaries: landowners
Intermediaries: brokers, consultants, non-governmental organisations
Government role: government sets the mandatory compliance mechanism

Duration: ongoing since February 2024

Summary
Based on new regulation in the UK, biodiversity net gain (BNG) is an approach to mitigating the biodiversity impacts of new land or marine property and infrastructure development and promoting sustainable land management, with the aim of leaving the natural environment in a measurably better state than before. Property developers will need to demonstrate how to achieve a minimum 10% net gain in biodiversity units in order to receive a planning permit. A biodiversity metric is used to calculate the biodiversity units needed to achieve the mandated 10% net gain.

1) What is the biodiversity net gain regulation?

The aim of the new biodiversity net gain (BNG) regulation from the UK government is to ensure that future development has a measurable positive impact on nature compared to the situation before development (Government of the UK 2023e). The BNG regulation aims to provide an incentive for private landowners to generate biodiversity units to sell. According to the UK's Department for Environment, Food and Rural Affairs (DEFRA), this would fund conservation activities on private land and initiate a new market for biodiversity units (Government of the UK 2023d).

The BNG regulation reinforces the mitigation hierarchy and is an additional tool for combating habitat and species loss. The BNG regulation addresses land-use change caused by property development as a driver of nature loss. The policy aims to leave the natural environment in a measurably better state than before. The activities associated with BNG can be delivered on-site or off-site, providing opportunities to generate payments for ecosystem services for other landowners (such as farmers). According to the biodiversity gain hierarchy, developers should first avoid or reduce any negative impact on biodiversity through site selection and layout; if developers can only achieve part of their BNG on-site, they can satisfy their requirements through a mixture of on-site and off-site activity and can buy statutory biodiversity credits as the last resort. Statutory biodiversity credits are different from off-site biodiversity units sold in the off-site private market (Government of the UK 2023d).

The biodiversity metric developed by DEFRA is used to calculate the value of habitats. It uses the extent and condition of habitat as a proxy for biodiversity and compares the situation before and after development occurs on the site. Prioritised location (strategic significance) and particular ecological characteristics such as habitat type, rarity and species richness within a habitat (distinctiveness) are the key factors to be considered in the comparison. For newly created or enhanced habitats, the metric takes into account the difficulty of creation or enhancement, the time required for a habitat to reach its target condition and the physical distance from the site where habitat loss occurs. The metric aims to quantify and evaluate different development design options to achieve better ecological outcomes. The formula calculates how many biodiversity units a habitat contains and how many units are needed to achieve the 10% net gain of biodiversity. The BNG activities will need to be maintained for at least 30 years and secured with a legal agreement by local planning authorities (Government of the UK 20203d).

2) How the economic mechanism works

The BNG is a market-based approach comprised of three parts (Government of the UK 2023d).

a) Developers are required to mitigate their impact on biodiversity. They must deliver a 10% net gain, either on-site or off-site, or as a last resort by buying statutory biodiversity credits.

b) Off-site landowners sell biodiversity credits on the BNG market. The credits provide a potential source of revenue for landowners and fund their nature recovery work. The landowners need to register a site onto the government's public Biodiversity Gain Site register and record the allocation of biodiversity units to be sold on the market. As a part of registering, landowners need to consult an ecologist who will measure the biodiversity value and advise on the habitat recovery process.

c) An official market exchange mechanism, operated by Natural England, brings developers and landowners together as a last resort when buying statutory biodiversity credits are the only option to fulfil BNG requirements. The UK government

provides the statutory biodiversity metric tool for calculating how many biodiversity credits are needed and reviews pricing of statutory biodiversity credits every six months. The biodiversity unit is a habitat-based proxy to describe biodiversity. It can be, for example, an area, a hedgerow or a watercourse. Prices per biodiversity unit vary depending on the ecosystem and if it is a specific or general type, from £42,000 to £125,000 for land ecosystems, and for watercourses the price can rise to £230,000. Transaction processes are defined for biodiversity units, which are dealt by brokers. The intermediaries involved in the processes are local authorities, philanthropists, non-governmental organisations and consultants (Government of the UK 2023b; Government of the UK 2023c).

3) Lessons learned

The BNG is an emerging instrument, with the legislation only introduced from February 2024. Thus, it is too early to say how it works in practice. For early adopters and to ensure an immediate supply of credits, producing biodiversity units has been possible for some time before the mandatory BNG regulation came into force (zu Ermgassen et al. 2021).

A recent UK government report suggested that once BNG becomes mandatory, up to 50% of the biodiversity units delivered by the policy would be supplied by off-site offsets. The biodiversity markets for BNG are expected to be worth between £130 million and £270 million annually. According to the study, the BNG market has been referenced as a potentially important revenue stream for funding the implementation of England's proposed new Local Nature Recovery Strategies and global biodiversity targets for 2030, for example the target to increase protected areas by up to 30% (EFTEC 2021).

Besides biodiversity benefits, the BNG also contributes to climate change mitigation and adaptation by aligning with local strategies. It can support health and well-being by creating green jobs and opportunities for people to act for nature. Any land delivering BNG is required to be managed, monitored and reported on for the duration of the net gain agreement. Additional statutory credits are being developed for large-scale projects, where BNG cannot deliver on- or off-site biodiversity credits. In general, BNG is meant to deliver high-value habitats and provide long-term nature-based solutions (Government of the UK 2023d). There is guidance on how landowners can combine BNG with other available environmental incentives such as nutrient mitigation payments (Government of the UK 2023b).

The empirical evaluation of the BNG based on data from early adopters identified four main threats to achieving the stated ecological outcomes of the policy (zu Ermgassen et al. 2021).

a) The magnitude of the offset demand in early-adopter markets was smaller than foreseen in government reports. Some 95% of biodiversity units were delivered through developer-managed land and only 5% through purchases of off-site credits from other landowners.

b) The classification of habitats or their condition levels are based on subjective assessment, with many classification judgements differing even between experts. The question of robustness regarding the classification and the biodiversity metric tool could undermine policy effectiveness. Local planning authorities rarely have the needed in-house ecological expertise to recognise possible gaps in the expertise in the reports from third-party consultants representing project proponents.

c) The developments studied delivered a 20% net gain in biodiversity units, but at the same time there was a 34% loss in greenspace areas within the total development area covered. This loss in habitat area was offset with habitats of smaller total area, but higher future

distinctiveness and condition. This creates pressure to have the appropriate governance in place for incentivising and regulating real-world implementation.

d) There is no guarantee that the biodiversity units delivered on-site and on developer-managed land will be either monitored or legally enforceable. Also, there are concerns that long-term ecological management measures may be insufficiently implemented. Compliance with on-site ecological mitigation and compensation measures in the United Kingdom is thought to be low and the lack of commitment to enforcement creates risks.

The BNG mechanism has applied lessons from other preceding offsetting mechanisms and has provided a stronger role for government, aiming to better link global and national biodiversity strategies, environmental payment policies, local level biodiversity priority setting and local nature recovery plans. More attention is given to a verification process by third parties and capacity building on intermediates than in preceding mechanisms. One of the most important lessons learned by DEFRA was that there should be enough time for stakeholders to adapt a new policy before it comes into force. The BNG mechanism has the potential to be the most promising offsetting mechanism developed so far.

2.1.2 German Impact Mitigation Regulation

Location: Germany, Europe

Ecosystem type: multiple

Mitigation hierarchy: avoidance, offset

Stakeholders
Lead: government; Federal Agency for Nature Conservation
Source of funding: projects that have a negative environmental impact
Beneficiaries: local or regional nature conservation administrations
Intermediaries: non-governmental organisations

Duration: Ongoing since 1976

Summary
The German Federal Impact Mitigation Regulation (IMR) serves as the legal basis for mandatory biodiversity compensation measures. Under the IMR, project developers are obliged to pay offset costs if their development projects have negative effects on biodiversity. The IMR uses biobanking as an offset approach.

1) What is the German Impact Mitigation Regulation?
The German Federal Impact Mitigation Regulation (IMR) aims to prevent net loss of biodiversity in Germany caused by development projects outside the agricultural, forestry or fishery sectors. The project types that fall under the IMR mainly comprise property development or transportation infrastructure. The IMR serves as the legal basis for mandatory biodiversity compensation measures. Under the IMR, project developers are obliged to bear offset costs if their development projects have a negative impact on biodiversity.

The regulation is nationwide, but the documentation, evaluation and organisational procedures and responsibilities reside at the state level. The regulation covers landscapes outside protected and conservation areas and is supplementary to European legislation as it excludes areas for offsetting that are already protected under Natura 2000. Development projects in the agricultural, forestry and fishery sectors are excluded, as long as they follow "codes of good practice" (Hunzai et al. 2018).

2) How the economic mechanism works
The IMR requires that negative effects are avoided when planning and executing a development project. If avoidance is not possible, offsetting is required. Negative effects are defined as effects on natural assets such as flora and fauna, soil, water, climate and air quality and the aesthetic quality of the landscape. Impacts on, for example, soil processes and productivity, groundwater replenishment and local climate regulation also need to be considered. Assessment of biodiversity impacts generally focuses on broad habitat types and sometimes on certain priority species. Each federal state retains lists of habitats and species that must be considered. The offsetting requirements consider ecosystem services as well as biodiversity (Hunzai et al. 2018; Tucker 2022).

Within the scheme, the project developer needs to estimate the expected degradation of the ecological value of the project site and calculate the credits needed to compensate for the degradation. The calculation can be based on the length and severity of the project and its impacts. The credits can be used to finance conservation measures off-site, implemented by a local or regional nature conservation administration (Hunzai et al. 2018).

The IMR uses biobanking as an offset approach, meaning that the monetary value of biodiversity and ecosystems are defined by calculating the value of ecosystem loss and compensation measures in credits. This is done before the development project starts to ensure that the biodiversity outcomes from offset projects are estimated beforehand. The ecological value of a credit is based on the size of a habitat and standardised values dependent on habitat types. The monetary value of a credit includes all costs of the compensation measure: planning, project implementation, monitoring and securities, risks and bridge financing (Hunzai et al. 2018).

Offsets can be implemented in a variety of ways. Implementation can be either project-related, on-site and off-site, or pooled in an eco-account as external compensation outside the planning area. Eco-accounts can be registries, in which the value of negative ecological impacts and compensation measures are registered as credits. After registration, the landowner can use the credits to offset their own ecological impacts or sell them to firms or individuals who can use them to compensate for their impacts. These are a collection of sites and compensation measures that can be relatively easily accessed by project developers. This has simplified the implementation of offset measures and decreased the risk that offset obligations are waived or reduced due to lack of available and eligible land area (Hunzai et al. 2018).

The project developers can offset their environmental impact by buying credits from the habitat bank. Providers can generate credits by protecting or enhancing biodiversity on their land. By selling the credits, landowners generate income that can be used for the implementation of biodiversity measures (compensation, mitigation or adaption) or for maintenance of the sites used for compensation (Hunzai et al. 2018).

There is no clear picture of the amount of financing for offsets that has been generated through the IMR. Tucker (2022) estimates that the overall costs of offsets (excluding transaction costs) are approximately €2.5 billion per year. This number is based on extrapolation of an estimation of total offsetting costs in the German state of Hesse (€70 million to €210 million depending on the range of standard per hectare costs, approximated at €150 million per year). Assuming that the state of Hesse represents an average German state, the extrapolation to €2.5 billion has been made. The payments for offsets are often estimated according to standard charges, rather than actual costs of the project, as these are only known at the end of the process. Standard per hectare costs for one-off forest establishment varies between €17,000 and €156,000, grassland establishment between €1,200 and €168,000 and wetland establishment between €36,000 and €172,000.

3) Lessons learned

An evaluation of the impact of IMR is difficult since the impact cannot be quantified and there has not been any overall evaluation of the instrument. There is no clear information on the monetary amount of compensation, excluding the extrapolated estimation, making evaluation of the instrument more difficult. Compliance is monitored and regulated by the German federal government. At the federal level, there are no standards or guidance on the assessment methods and metrics that should be used to quantify impacts and required offsets. As a result, a wide variety of approaches have been used in different states, which makes the overall

evaluation of IMR difficult since there is no national-level assessment (Tucker 2022).

According to Tucker (2022), a substantial proportion of offsets have failed to achieve their objectives. One potential reason is that IMR initially employed strict criteria on the similarity of the offsetting area and the area where the environmental impact occurred, leading to a lack of available compensation areas. In addition, there have not been clear requirements for authorities to monitor the long-term performance of the offsets. The IMR has been around for a relatively long time, and there have been amendments to the legislation concerning the strict regulations for the similarities of the locations for offsetting, which has led to a more efficient and effective offsetting process.

As agricultural, forestry and fishery-related activities are not included within the scope of the legislation, the impact of IMR is significantly constrained (Hunzai et al. 2018; Tucker 2022).

The IMR is a successful case of mandatory offsetting of biodiversity impacts of projects. The assessment methods and gathering of information related to the scheme's impact could improve in terms of consistency. The roles and responsibilities of relevant authorities should be clearly defined before implementing this kind of instrument. The exclusion of projects involving the agriculture, forestry and fishery sectors restricts the scope of impact of the instrument, as many projects resulting in negative ecological impacts are out of scope.

2.1.3 Wetlands Compensatory Mitigation Rule in the USA

Location: USA, North America

Ecosystem type: wetlands

Mitigation hierarchy: avoidance, restoration, recreation, enhancement

Key stakeholders
Lead: US Environmental Protection Agency and US Army Corps of Engineers
Source of funding: projects that seek exempt permits for development and need mitigation compensation schemes
Beneficiaries: mitigation banks or a trust that offers mitigation credits
Intermediaries: Department of Natural Resources of Wisconsin (DNR) or similar state-level governmental organisations
Government role: government sets the mandatory compliance mechanism via its agencies

Duration: Ongoing since 2008

Summary
The US compensatory mitigation of wetlands aims to offset unavoidable adverse impacts of development activities on wetlands that remain after all appropriate and practicable avoidance and minimisation measures have been taken. There are three mechanisms available that govern how the compensatory areas are established. While the mitigation regulation is considered successful, performance standards are vague and there is a need to develop a compensation performance evaluation strategy (Hough and Harrington 2019).

1) What is the Wetlands Compensatory Mitigation Rule?

The Clean Water Act (CWA) prohibits point sourced discharge of pollutants, dredged or fill material into waters in the United States, unless authorised by the Army Corps of Engineers (USACE) or approved by the state under CWA Section 404. According to the legislation, which is based on the principles of the mitigation hierarchy, authorised discharge must be avoided and minimised and unavoidable impacts must be compensated for.

To enact the CWA, the purpose of the US compensatory mitigation is to offset the unavoidable adverse impacts of on-site development or upstream sources on wetlands that remain after all appropriate and practicable avoidance and minimisation measures have been taken. Compensatory mitigation plans may generate mitigation credits using four methods:

1. the restoration of a former wetland;
2. the establishment (creation) of a new wetland;
3. the enhancement of an impaired or degraded wetland;
4. or, in certain circumstances, the preservation of an outstanding wetland.

Under the regulation of compensatory mitigation, there are three mechanisms available for offering compensatory areas:

1. mitigation banks;
2. in-lieu fee programmes;
3. permittee-responsible mitigation.

In this case study, we use the state of Wisconsin as an example of compensatory mitigation in practice (Wisconsin Department of Natural Resources 2023). However, the principles of the economic mechanism are the same across the USA.

2) How the economic mechanism works

In Wisconsin, guidelines, criteria and site requirements are retained by the State Department of Natural Resources. Mitigation banking in Wisconsin is divided into 12 watersheds, known as service areas, within which mitigation banks may sell credits. Credits are only valid within their respective service areas. A permit applicant is an entity proposing an activity that will have unavoidable adverse impacts, who must apply for a permit to compensate for these impacts.

In mitigation banking, a permit applicant can purchase credits from approved mitigation banks, which operate on a for-profit basis. Wetland mitigation banks contain credits associated with restored, enhanced or created wetlands, which can be used to offset unavoidable impacts to existing wetlands. Any individual or entity may establish and operate a wetland mitigation bank, but they are regulated by USACE and the Department of Natural Resources of Wisconsin (DNR). Federal regulations establish a flexible preference for using credits from a mitigation bank over the other compensation mechanisms because it is a reliable and verifiable method of wetland replacement.

Under the in-lieu fee programme (compensation programme), credits can be bought from the DNR Wisconsin Wetland Conservation Trust (WWCT). WWCT sells wetland credits to permittees needing to offset authorised wetland impacts. After the USACE have determined that the permit applicant must purchase WWCT credits to compensate for unavoidable impacts to wetland resources, the WWCT creates an invoice for the credit purchase, and the applicant sends the funds to the WWCT. After the contract is complete, the WWCT holds all legal responsibility for the mitigation. However, in-lieu fee programmes are not required to provide the same financial assurances as mitigation banks.

Once the permit applicant has calculated the required mitigation credits for the proposed project, they should use the Regulatory In-Lieu Fee and Bank Information Tracking System (RIBITS) to obtain information about approved mitigation banks and in-lieu fee programmes that may provide appropriate credits. In mitigation banking and in-lieu programmes, the value of credits is determined by quantifying the wetland functions or the acres of wetland restored or created. Compensatory mitigation credits are released, and the mitigation banks and trusts are allowed to sell credits to satisfy the mitigation requirements of permit applicants.

Wetland mitigation credits are sold on a per acre basis. The transaction value depends on wetland state and function, impact activity, credit type and the overall market demand. Since the mitigation seller determines the asking price for each wetland mitigation credit, the final price of each credit will be influenced by the total number of credits purchased by the buyer. The final price for the purchased credits is negotiated between the buyer and the seller (Fenstermaker 2023).

An option less favoured by the USACE and the Environmental Protection Agency (EPA) is permittee-responsible mitigation, where the permit applicant can satisfy their compensatory mitigation requirement by completing a mitigation project in the same watershed service area or within half a mile of the wetland impact site. However, the long-term success of permittee-responsible mitigation has been dismal, as many projects

were never implemented or did not satisfy ecological requirements. Also, they were often costly and owners challenged the regulation (Bonds and Pompe 2003).

3) Lessons learned

In Wisconsin, annual reports are completed for the in-lieu fee programme and biennial reports for the whole Wetland Compensatory Mitigation Programme. The latest biennial report states that 113 wetland permits or authorisations were issued by the department that required the purchase of over 148 wetland mitigation credits. Seven new mitigation banks were established and five new in-lieu fee mitigation sites were constructed over the two-year period, resulting in 1,341 acres (approximately 540 hectares) of restoration and the generation of 314 wetland credits for permittees. Since 2012, wetland mitigation in Wisconsin has resulted in the restoration of 3,861 acres (approximately 1,560 hectares) and generated 1,930 wetland mitigation credits (WDNR 2023).

In 1980, the EPA and the USACE jointly expanded the Section 404 guidelines to include comprehensive standards for compensatory mitigation. A major evaluation of the compensatory mechanism was carried out in 2008. Before 2008, the compensatory mitigation policy recommended that the offset projects should be as physically close to the impact site as possible. The new recommendation instead directed compensatory mitigation projects to locations that most effectively address the most pressing ecological needs in each watershed. The new rule established in 2008 also stated that all projects must have a detailed monitoring plan and a long-term management plan identifying the annual management tasks, who is responsible for the management and how it will be funded. However, many performance standards in the Section 404 guidelines are too vague to be meaningful and enforceable. Moreover, monitoring and reporting requirements are too vague to track project development and/or determine project compliance. Also, there are deficiencies in identifying ongoing management tasks and estimating management costs. This raises questions about whether long-term management funding provided will be adequate and sustainable. There is also a need to develop a compensation performance evaluation strategy, as this is currently missing (Hough and Harrington 2019). Following this criticism, the EPA has published guidelines and frameworks for evaluation and reviewing compensatory mitigation projects (Stein et al. 2022; Ainslie et al. 2023).

Hough and Harrington (2019) found that since the change of the policy in 2008, the number of mitigation banks and in-lieu fee programmes has risen considerably. The shift to using mitigation banking and in-lieu programmes instead of permittee-responsible mitigation saves time for the permit applicants. Wilkinson et al. (2019) note that this also could result in a reduction in overall project costs, benefiting permit applicants.

2.2. Payments for ecosystem services

2.2.1 The Forest Biodiversity Programme for Southern Finland (METSO)

Location: Finland, Europe

Ecosystem type: orest (boreal)

Mitigation hierarchy: enhancement, restore

Key stakeholders
Lead and source of funding: Government of Finland via the Ministry of the Environment and the Ministry of Agriculture and Forestry
Beneficiaries: non-industrial private forest owners, including in some capacities Metsähallitus, the Finnish state's organisation that managers and protects state-owned land
Intermediaries: Regional Centres for Economic Development, Transport and the Environment and the Finnish Forest Centre
Government role: lead and source of funding

Duration: ongoing since 2006

Summary
The METSO programme aims to halt the decline in the biodiversity of forest habitats and species. It contains 14 measures, including voluntary PES measures for non-industrial private forest owners to improve the network of protected areas, to enhance habitat management in commercially managed forests and to create collaboration networks. The foregone forest revenue and the costs of nature management projects and collaborative networks are compensated for.

1) What is the METSO programme?
The METSO programme started with a pilot programme of 17 measures carried out from 2002 to 2007. In 2006, the measures were assessed for their ecological impacts, social acceptability and cost-efficiency. The first 2008-2016 METSO programme was prepared in collaboration with stakeholder groups. A new programme was launched in 2013 for the period 2014-2025 and it is still ongoing. The preparation of the next programme is planned to be initiated soon.

The objective of METSO is to establish a total of about 96,000 hectares of forest, containing both public and private forests, as permanent or temporary nature reserves by 2025. In addition, about 82,000 hectares of valuable forest habitats in commercially managed privately owned forests are planned to be protected by fixed-term environmental forestry subsidy agreements or to be managed or restored in nature management projects. The geographical focus is on Southern Finland (METSO 2023).

In non-industrial private forests, the state plays three main roles. First, compensating forest owners for either permanent or fixed-term (10 or 20 years) contracts for reserved areas. Second, covering the costs of planning and implementing restoration

projects of forestry or environmental professionals. And, third, funding project-based collaboration networks of forest owners (METSO 2023).

The programme targets the protection of habitats as opposed to specific species. The estimation of biodiversity impact, such as ecological connectivity and quality of the protected sites, is based on research findings and assessment reports (Hohti et al. 2019). Research topics include the ecological quality of sites protected in the METSO programme and the impacts of forest-management methods based on natural disturbance dynamics. Ecosystem services, such as recreation, tourism and cultural and landscape value, are provided in the collaboration networks. Many nature management projects target water quality and maintenance of small water bodies and shore environments. The measures also build up carbon storage (METSO 2023).

2) How the economic mechanism works

The funding for compensation and projects comes from the state budget. In 2021, the average compensation payment for a 10-year contract was 2,116 €/ha, for a 20-year contract 2,330 €/ha and for private conservation areas 6,820 €/ha. The average compensation amount paid to a forest estate was €5,800 for 10-year contracts, €23,200 for 20-year contracts and €57,100 for private conservation areas (Koskela et al. 2022). In 2008, the budget allocated to implement the METSO programme on private land was initially €15.6 million, growing to €43 million in 2021.

The compensation for private permanent conservation areas is calculated based on the gross market value or harvesting value of the trees. Costs such as taxes and forestry expenses are then deducted from the gross value using a correction factor. The magnitude of the correction factor varies case by case, often ranging from 15 to 30%. It is influenced by the forestry values of the property, such as harvesting opportunities, logging conditions and the location of the area. As there is no change of land ownership, there is no compensation provided for land value.

For the 20-year contracts the compensation is determined using the SuojeluMotti software developed by the Natural Resources Institute Finland (Luke 2024). SuojeluMotti calculates the economic loss resulting from protection based on the most economically favourable forestry treatment option, which often involves regeneration harvesting (METSO 2023).

The compensation includes factors such as the lower growth of the timber than in optimal timber production and the tying up of capital when final harvesting is delayed. The amount of the temporary protection compensation depends on the characteristics of the property and can vary significantly in different regions depending on these features (METSO 2023).

The compensation for a 10-year contract consists of basic compensation, harvesting value compensation and other compensation. The basic compensation is calculated based on the average stumpage price of a cubic metre of wood multiplied by two and by the area of the site. A compensation amount for the harvesting value is based on the tree harvesting value of the protected site minus the cost of minor damage. The threshold value for minor damage is 4% of the value of immediate harvesting potential, the maximum being €3,000. The determination of the harvesting value uses the average of the actual stumpage prices for the three preceding calendar years based on the province. The provincial average stumpage prices are confirmed by the government via regulation. Other compensation includes bonus payments for decayed wood in densely forested sites, up to a maximum of 20% of the total compensation amount (METSO 2023).

Other compensation may be paid for the preparation of the environmental support application, planning for the management of

habitat sites and the implementation of management activities by external parties. Environmental support compensation is considered taxable capital income from forestry for the forest owner.

3) Lessons learned

Since its start until the end of 2022, the programme had protected 88,878 hectares of forest land, which is 93% of the target amount (Anttila et al. 2023). Further, fixed-term contracts and nature management on private land have achieved 73% of the target 82,000 hectares. In the sense of achieving the intended hectarage target, the programme seems to be a success if the rate continues until 2025.

The implementing parties assess the programme and the collaboration networks on a yearly basis (METSO 2023). Three interim evaluations have been conducted by impartial experts from the fields of ecology and social sciences (in 2010, 2012 and 2018, available at METSO 2023). All reports are public and freely available. According to the latest assessment report, the programme has enabled the creation of a protected areas network that is of a reasonably high ecological quality (Hohti et al. 2019). Apart from the biodiversity benefits, the set-aside areas serve simultaneously as carbon storages.

Also, the National Audit Office of Finland (Valtiontalouden tarkastusvirasto 2023) states that the quality of conservation has been good. However, they recommend that the ministries further develop the cost-effectiveness and impact of the programme. In particular, the appropriateness of fixed-term contracts should be evaluated as they involve a risk of the area returning to commercial forestry after the contract matures.

According to the evaluations of the programme, the collaborative and voluntary-based programme has enhanced forest owners' interest in safeguarding nature and empowered them to make decisions on their own land.

The success of the METSO programme lies in the extensive involvement of stakeholders and researchers, and its voluntary nature, which has guaranteed strong support for the programme. Achieving the hectare-based targets for environmental subsidies and nature conservation would require a clear increase in national funding levels for the remaining period of the action plan. Also, intermediary partners have been particularly under-resourced for implementing the programme (Hohti et al. 2019).

2.2.2 The Burren Programme: hybrid agri-environmental scheme

Location: Ireland, Europe

Ecosystem type: agricultural

Mitigation hierarchy: minimise, restore

Stakeholders

Beneficiaries: farmers in the region
Intermediaries: the administration of the Burren Programme is delivered under contract by High Nature Value Services (HNVS) Ltd; independent farm advisers approved by the programme liaise with farmers, conduct farm audits and assemble farm plans
Government: lead and source of funding

Duration: ongoing since 2010

Summary
The programme is a hybrid agri-environmental payment scheme, where farmers qualify for a retroactive subsidy based on costs of conservation measures undertaken on their property and the conservation results of each high nature value (HNV) field measured using the environmental health score (1-10) by a farm adviser. The two approaches are closely linked: targeted conservation measures help to improve conservation results and results-based payments.

1) What is the Burren Programme?
The Burren Programme focuses on the management of extensive limestone pastures in the Burren region of Ireland. The ancient practice of winter grazing maintains the distinctive character and biodiversity of the area, which is rich in rare plant and animal species. There are about 450 farms containing about 30,000 hectares of high nature value (HNV) farmland. HNV farmlands are agricultural areas with important natural value. They are often characterised by low intensity of land use, presence of semi-natural vegetation and presence of a landscape mosaic. The Burren area is facing loss of species-rich grassland habitats due to under-grazing of habitats and scrub encroachment. The programme aims to preserve and restore the valuable grassland habitats in the Burren, as well as the rare species growing there (Burren Programme 2023; EFNCP 2024).

The programme is based on the experiences of the BurrenLIFE project carried out between 2004 and 2010. Despite its success, the project highlighted that the existing action-based agri-environmental payment system was not sufficient for addressing the environmental issues of the Burren HNV farmed landscape. To address the limitations of an action-based approach, a hybrid system was developed. Incentives for qualifying farms are divided into two components: payments for conservation measures and payments based on an environmental performance field score (1-10). A score of at least five is required to qualify for the performance-based payment, with bonus payments

made for exceptional scores between 9-10. The two incentive components are synergistic since targeted conservation works and improved management help to increase field scores and their associated payments (Burren Programme 2023; HNVLink 2022).

2) How the economic mechanism works

The Burren Programme is funded by the Irish Government with partial funding from the European Agricultural Fund for Rural Development. The leading government office is the Department of Agriculture, Food and the Marine (DAFM). The National Parks and Wildlife Service of the Department of Housing, Local Government and Heritage contributes towards office costs (Burren Programme 2023).

In the first action-based component of the incentive, each farm is allocated an annual operational budget based on the HNV area of the farm. The farmer chooses and carries out suitable conservation measures, for example scrub control or habitat restoration, with guidance from a trained farm adviser. Depending on the measure, the farmer receives payment for 25-75% of the cost of the completed work (Burren Programme 2023; HNVLink 2022).

In the subsequent results-based component of the incentive, the farm adviser assesses the environmental health of every HNV field within the farm annually using a field score that ranges from 0 to 10. The field score is calculated using specific criteria, including grazing level, extent of erosion and damage of natural water sources, amount of encroaching scrub and weeds, and ecological integrity (Burren Programme 2023).

The annual output payment for each field is calculated by multiplying the field score by the available payment rate per hectare and by field size. Fields with a score of six or higher receive payment, fields scoring 9 and 10 have higher payment rates. Annual payments range from €8 per hectare to €180 per hectare depending on field score and farm size. Smaller holdings are rewarded by larger per hectare payments. The output payment gives farmers an incentive to manage their fields in ways that improve their scores and thus their natural value (Burren Programme 2023; HNVLink 2022).

From 2010 to 2014, the estimated annual average payment to farmers was €6,600, or €33,000 per farmer over five years. The farmers were paid in total €4.935 million, and an additional estimated €1.335 million was invested by farmers themselves through the co-funding of activities and infrastructure incentivised by the scheme over these five years (Burren Programme 2023).

3) Lessons learned

According to an official evaluation, the programme has been successful and has been found to have a positive impact (AECON 2020). The success of management on each farm is measured using environmental performance scoring provided by third-party trained farm advisers. The Burren Programme team reviews the farm scores for accuracy and consistency, in addition to a partial review undertaken by government agricultural inspectors (Burren Programme 2023).

According to an evaluation carried out in 2020, the programme has contributed to improvements in landscape and habitat quality, increased biodiversity and reduced scrub encroachment on endangered habitats. The farm measures have also contributed to water quality in the area (AECON 2020). Due to its success, the programme was expanded in 2016 to the entire Burren region of 30,000 hectares under Ireland's Rural Development Plan (HNVLink 2023).

The Burren region is important for Irish heritage, and according to the evaluation conducted, the Burren Programme has helped to provide social and economic benefits to the local community. The programme also includes measures to ensure the protection of archaeological monuments and heritage buildings on farmland in the Burren (Burren Programme 2023; AECON 2020).

The success factors of the case include a high level of buy-in by farmers, a solid research base built on the BurrenLIFE project, a strong advisory system and an innovative hybrid incentive system. The strong government role, both as a funder and lead of the programme, has been an important enabler of success. The system may well be transferred to other regions or adapted for other agri-environmental objectives.

2.2.3 Payment for environmental services in Costa Rica

Location: Costa Rica, Central America

Ecosystem type: forest (tropical)

Mitigation hierarchy: avoidance, restore

Key stakeholders
Lead and source of funding: the Government of Costa Rica
Beneficiaries: forest owners
Intermediaries: Fondo Nacional de Financiamiento Forestal (FONAFIFO)
Government role: the government is the initiator and administrator of the programme and provides the majority of funds.

Mechanism of revenue generation: payments for ecosystem services

Duration: ongoing since 1997

Summary
Costa Rica's national payments for environmental services programme (PES) aims to promote forest ecosystem conservation and combat land degradation. Landowners receive direct payments for the environmental services that their lands produce as a result of sustainable land-use and forest-management techniques.

1) What is the Costa Rican payments for ecosystem services programme?

The programme was initiated in 1997 to address rapid deforestation and loss of biodiversity in the forests of Costa Rica. The programme was the first of its kind in Latin America and has been an inspiration for, among others, the payment for hydrological services programme in Mexico and the Procaryn programme in the Dominican Republic (Global Environment Facility 2014; IIED 2012; León et al. 2013; UNFCCC 2020).

The programme compensates landowners for provision of environmental services: biodiversity protection, water regulation, carbon sequestration and landscape value. The programme's key initiatives include conservation of natural forests, forest management and reforestation through sustainable plantations or natural regeneration (FONAFIFO 2023; UNFCCC 2020).

2) How the economic mechanism works

Within the programme, the government pays the owners and holders of forests and forest plantations, who may be leasing the land or managing it with indigenous communities' rights, for the environmental services they provide. Incentives include direct cash transfers to incentivise private landowners to engage in 5 or 10-year contracts for forest protection, reforestation and sustainable forest management. The payment system is managed by Costa Rica's national forestry fund, Fondo Nacional de Financiamiento Forestal (FONAFIFO) (UNFCCC 2020).

The programme is partially funded through Costa Rica's fuel tax and water charge, and partially through other sources, such as certificates for conservation of biodiversity, carbon credits and strategic alliances with the public and private sector. Previously, the programme was also funded

by a World Bank loan, as well as grants from the Global Environment Facility (GEF) facility and the Governments of Germany and Norway (FONAFIFO 2023; Global Environment Facility 2014).

The payment rate varies according to the type of contract. The payment rate is based on the type of ecosystem services provided. Payment rates and the annual budget for each type of contract are fixed annually in a ministerial resolution. They are subject to readjustment according to the Consumer Price Index. In 2023, the payment for a 10-year contract for forest protection was 370,000 Costa Rican colones (CRC) (€630) per hectare, and an additional sum of 92,000 colones (€155) was paid for sites of particular importance for water provision services. The payment for a five-year contract for natural regeneration was 120,000 colones (€200) per hectare in 2023. Payments are made in annual instalments (FONAFIFO 2023; FONAFIFO 2024).

3) Lessons learned

Costa Rica's PES programme has been considered the world's most successful national-level application of the PES due to its success in promoting reforestation and its social and economic benefits described below (Global Environment Facility 2014). It was named in 2020 as a UN Global Climate Action Award winner. A similar system has been applied in other countries in Latin America, for example the payment for hydrological services programme (PSAH) in Mexico initiated in 2003 (León et al. 2013; Secretariat of the Convention on Biological Diversity 2006).

The programme has, together with other initiatives, helped to reduce the rate of deforestation in Costa Rica from one of the world's highest to a net increase in forest cover by the start of the 2000s. This has significantly contributed to halting and reversing biodiversity loss in this ecosystem. The programme has also helped to maintain water provision services as well as carbon storage and sequestration (Secretariat of the Convention on Biological Diversity 2006).

Staff from the Control and Monitoring Department of FONAFIFO supervise the programme activities through regular visits to participating forest farms. The number of visits each year depends on the available budget. Visits are planned based on a random sample, considering also some priorities like alerts about potential problems. During the field visit, the forest areas and their condition are monitored. Drones are sometimes used to verify the areas. Satellite images may also be used to complement information collected during field visits. Each project has a legal contract associated with it, which is signed by the owner of the property. If there is a breach, there are legal consequences, and if the area has been highly affected or deforested, the owner must return the money paid (FONAFIFO 2024).

FONAFIFO Environmental Services Management Department reports the number of contracts, amounts of payment, forest area and type of beneficiaries annually. These statistics are available online on the FONAFIFO website (FONAFIFO 2023; FONAFIFO 2024).

One of the success factors of the programme is the social and economic benefits it provides for the local people. According to UNFCCC (2020), the programme has benefited over 18,000 families between 1997 and 2019. There are special conditions for Indigenous Territories and the programme promotes their participation in the protection of forests with around 100,000 indigenous people benefiting from the programme.

2.2.4 Reverse auction pilot scheme for biodiversity protection in Denmark

Location: Denmark, Europe

Ecosystem type: forest (temperate)

Mitigation hierarchy: enhancement

Stakeholders
Lead: Danish Forest Association and University of Copenhagen
Source of funding: EU HORIZON programme
Beneficiaries: forest owners
Intermediaries: environmental non-governmental organisations
Government role: the EU funded the project

Duration: 2018-2022

Summary
The project tested the use of reverse auctions for allocating incentive payments for forest owners to set aside their land for biodiversity conservation.

1) What is the reverse auction pilot scheme for biodiversity protection?
The majority of the Danish forest area is located on private land and ownership is distributed between nearly 25,000 private individuals, foundations and businesses. Forest owners are interested in pursuing biodiversity and habitat protection, if these are supported by appropriate incentives. Privately owned forests provide important biological corridors and microhabitats and support a significant number of endangered animal and plant species. It is therefore important to include these areas in conservation efforts. Grant schemes need to be redesigned to make biodiversity conservation efforts and protection of key habitats more attractive and more cost-effective to forest owners (SINCERE project 2022).

The reverse auctions pilot was conducted to examine alternative ways to support biodiversity protection and improve public grant schemes. Specifically, this pilot aimed to demonstrate how a competitive bidding process could improve cost-effectiveness and buy-in among landowners. While imposing some restrictions, the reverse auction provided forest owners the flexibility to decide which conservation actions to offer and set the requested price to complete the actions (SINCERE project 2022).

2) How the economic mechanism works
Reverse auctions are auctions where the seller with the lowest proposed price for a certain service or commodity wins. In this case, conservation measures were put to auction by the forest owners who designed the conservation measures and set the prices for those measures. The bids with highest biodiversity impact relative to their price were successfully funded by the auction organisers. To help design their bids, forest owners received a description of the information that should be included, as well as access to research-based recommendations about different types of measures that can be offered. The auction pilot scheme was

organised by the Danish Forest Association and University of Copenhagen as a part of the EU HORIZON SINCERE project.

The auctions were held in 2020. In the auction, there were 24 different bids from the forest owners, which amounted to services offered totalling more than €180,000 more than three times the available reserve budget, indicating that the auction was competitive. The forest owners whose bids were accepted received compensation in the range of €5,000 to €15,000 per hectare for setting aside mature forest for permanent revocation of production rights on said land.

The research group held information campaigns for forest owners during spring 2020, to reach relevant target groups. There were also meetings for key stakeholders (forest owners, environmentalists, policy-makers, scientists and forest user groups), in which feedback and suggestions for auctions were collected.

3) Lessons learned

In all fulfilled bids, it was reported that the landowners had managed the contracted areas in a way that supported the potential for biodiversity protection. The contracts also applied further restrictions on future management of the areas, which suggests that there might be more benefits for biodiversity protection in the future, but these future benefits were not specified (SINCERE project 2022).

During the auction process, the main challenge was the assessment of the long-term potential of each bid, and the impacts on key threatened and vulnerable species. After the auction, the bids were ranked according to their biodiversity benefits, the current situation and likely future development. After the ranking, the projects were evaluated by their cost-efficiency by assessing which of them would provide the highest level of biodiversity protection per euro (SINCERE project 2023).

In a self-assessment of the pilot project, it was given high marks for overall sustainability: ecological, economic and social aspects were each assessed as being over 4 (in a range of 1-5). According to the self-assessment, the strengths of the auction pilot scheme were the resulting expected biodiversity impacts and the high number of bids submitted relative to budget. The proposals in the bids were of high quality and there was good price competitiveness (Katila et al. 2022).

However, there was variation in the pricing of the bids and the prices did not always correlate with the ecological performance of the bid. The lack of standardisation in the proposed measures allowed for cost-effectiveness because the forest owners could design the measures themselves. However, this variation of proposals increases the importance of a rigorous selection procedure and criteria for ensuring that ecological benefits will be delivered in correlation to the price of the bid. Compared to granting subsidies based on standard eligibility rules, more preparation and competence are needed when organising this type of auction, because of the variance of included measures, expected ecological benefits and associated prices, so there is a need to ensure the quality of the bids. This was assessed to be the weakest point of the pilot scheme in the self-assessment when considering the potential to upscale the scheme. One of the other main challenges in upscaling the auction mechanism in Denmark is availability of funding. The project group assessed that without funding from the government or private nature protection agencies, auctions cannot be upscaled (Katila et al. 2022).

2.2.5 Agriculture Biodiversity Stewardship – Carbon + Biodiversity Pilot

Location: Australia, Oceania

Ecosystem type: forest, agricultural

Mitigation hierarchy: restore

Key stakeholders
Lead and source of funding: Australian Government's Agriculture Stewardship
Beneficiaries: farmers, landowners
Intermediaries: Australian National University (ANU), regional Natural Resource Management (NRM) organisations
Government role: lead and source of funding

Duration: ongoing since 2021

Summary
The Carbon + Biodiversity Pilot is testing the functioning of simultaneous biodiversity enhancement and carbon sequestration markets. It also creates new income opportunities for farmers for activities such as environmental tree and shrub planting. Under the pilot scheme, landholders can gain multiple benefits by completing a project and maintaining it for at least 25 years. The authorities rank applications from landowners based on cost-effectiveness in producing biodiversity benefits. Measures incentivised by the scheme also provide co-benefits to farms and other landscapes in terms of shelter for stock or other animals, protecting dams and waterways and reducing soil erosion.

1) What is the Carbon + Biodiversity Pilot?

The Carbon + Biodiversity Pilot (C+B) is part of the Australian Government's Agriculture Stewardship Package. The scheme has been designed and delivered in partnership with the Australian National University (ANU), setting the rules on participation and contributing with the assessment reporting and the monitoring processes, and the Natural Resource Management (NRM) organisations in each trial region (DCCEEW 2023a).

Landholders participating in the C+B Pilot plant or sow native trees and shrubs on land that has been clear of forest for more than five years. The aim is to achieve biodiversity restoration while simultaneously contributing to carbon sequestration. Participants in the scheme must maintain their projects for at least 25 years, but a 100-year period is also an option if the project is also registered under the Emissions Reduction Fund (DCCEEW 2023a).

Projects can be developed on land, on inland lakes and rivers, in coastal environments within 22 kilometres of the low water mark of the Australian mainland or islands. Projects may include the improvement or restoration of native vegetation (through activities such as fencing or weeding), the planting of local native species and the protection of rare grasslands providing habitat for endangered species. Activities such as restoring and improving damaged areas and establishing new growth to

promote biodiversity and habitats is also included (DCCEEW 2023b).

Trees and shrubs are established and maintained in accordance with the applicable regional planting protocol. The planting protocols specify location, dimensions, configuration and composition of the plants, as well as the rules on their proximity to houses and other infrastructure. The protocols aim to maximise biodiversity benefits (DCCEEW 2023a).

The application process consisted of two rounds: the first round took place in 2021 and the second closed in 2022. The projects were selected and planting started in 2022 (DCCEEW 2023a). No further application rounds have been announced. The two application rounds covered 12 different regions across the Australian states of Queensland, New South Wales, Victoria, Tasmania, South Australia and Western Australia.

2) How the economic mechanism works

Participants who establish and maintain planted vegetation in accordance with the C+B protocol will receive payments for biodiversity improvements and Australian Carbon Credit Units (ACCUs) for the carbon sequestered. Participants will be able to sell the ACCUs to the Australian Government or other buyers, which would provide an additional source of revenue for the projects (DCCEEW 2023a; DAWE 2021). All projects under the pilot scheme are subject to measurement, reporting and verification requirements (DCCEEW 2023a). Eligible applications are assessed and ranked to determine a biodiversity payment offer and a biodiversity benefit score.

The biodiversity payment offer is determined through one of the following options. With Option A, applicants submit cost estimates for their project and, if successful in the selection process, they will receive a biodiversity payment offer that takes into account their estimated costings. With Option B, applicants submit their own bid price for the biodiversity payment they are willing to accept, along with their project costs. If they are successful in the selection process, they will receive a biodiversity payment offer based on either the bid price or the estimated costs of the project (DAWE 2021).

With Option A, the final price is determined by a financial model that incorporates an estimate of the ACCUs that would be created by the project, the estimated price of those ACCUs and then subtracts this amount from the initial cost of the project to determine an appropriate payment offer for each application. An internal rate of return is targeted for each project to attempt to attain profitability for participants and thus maintain attractiveness of the scheme.

The cost of the project is initially estimated by the applicant landowner, with the ANU team applying cost caps if necessary when making a final assessment of the cost of the project. Cost caps are set for each cost component in each region based on the prevailing market prices of relevant goods and services. If an estimate by an applicant for a cost component exceeds the relevant cap price, the cap price will replace the applicant's estimate when generating the payment offer or testing the competitiveness of the bid price. The required information of project costs included site preparation (weed control), soil preparation, tubestock or seed, and total planting costs, tree guards and fencing and recurrent management (such as weeding and pest control). Price guides for each region were made available to landowners to help them with their project costings (DAWE 2021). With Option B, the possible biodiversity payment offer is maintained at the participant's original bid price. However, the competitiveness of each bid is tested by generating a "shadow payment offer", using the same pricing model that is used for Option A.

The biodiversity benefit scores of applications are calculated using a methodology developed by ANU. The biodiversity benefit

score reflects the predicted future biodiversity value of the project and its contribution to biodiversity conservation across the region. The score is calculated based on a number of factors, including the size of the proposed planting areas, the location of the planting areas and their association with threatened species and ecosystems, the presence of mature trees that provide habitat for biodiversity within the planting area, whether the planting area is near watercourses or other water bodies, and the applicant's choice of permanence period (projects that opt for 100-year permanence periods will be given a higher score) (DAWE 2021).

Projects were then ranked according to a benefit-cost score that is based on the biodiversity benefit score and biodiversity payment offer. The benefit-cost score is an indication of project's cost-effectiveness (the biodiversity benefit they delivered per dollar). This information is provided in an Assessment Report to the Assessment Panel who determine whether and what offer to make to each eligible project and rank each application according to the score. Applicants that submit more cost-effective planting projects are more likely to succeed. In some cases, the panel asked questions or for amendments prior to proceeding. The department then made offers to applicants following appropriate ministerial approval (DAWE 2021; DCCEEW 2023a).

In C+B, landholders receive biodiversity payments largely upfront. In the first round, 50% was paid upfront upon unconditional ACCU scheme registration, and in the second round this amount was increased to 80%. The upfront payment acknowledges that most of the project costs incur in the beginning of the project. The remainder of the payment is paid in two equal instalments over the subsequent two to three years (Jacob et al. 2023).

3) Lessons learned

According to the assessment by Jacob et al. (2023), there were 80 applications in the first round, and 65 received payment offers and management agreements. Out of them, 38 withdrew their applications, not accepting an offer because of the price, complexity, timeline or other reasons. Only 24 accepted the offer, and three remained undecided at the time of the assessment made by Jacob et al. (2023). In the second round, there were 73 applications and 53 received offers. Out of them, 12 withdrew their applications and 41 accepted the offer. It seems that higher offers, a larger proportion of upfront payment and funds available for seeking professional advice in the second round were critical factors in reducing the number of withdrawals (Jacob et al. 2023).

A landowner survey showed that the key motivations for participating were environmental attitudes, holistic property management and additional revenue streams. The pilot schemes have also demonstrated that building trust is integral to landholder motivation to participate in the market. As widespread landholder participation in the market is crucial for achieving broader biodiversity targets, it is important to simplify the application and assessment process, provide information through channels that reach different stakeholders and involve these stakeholders in market design to motivate applications and retain high programme participation (Jacob et al. 2023).

The assessment by Jacob et al. (2023) underlines the importance of investing time in testing the mechanism, process and document design prior to launching the market. Careful design can help avoid costly mistakes and losing the trust of landowners. For example, in the first round, there was confusion about the eligibility of landholders in both the C+B and the ACCU schemes.

The projects funded within the pilot scheme provide habitats for a wide range of native species and vegetation corridors in landscapes, contributing to the improvement

of the regional biodiversity. The projects also contribute to carbon sequestration, providing an example of reconciling both benefits within a single programme. In addition to biodiversity and climate benefits, the programme provides landowners with additional income. Planting also provides co-benefits to farms and other landscapes in terms of shelter for livestock or other animals, protecting dams and waterways and reducing soil erosion. Broader benefits include supporting market access by improving the biodiversity credentials of Australian agriculture, creating price premiums for agricultural products across supply chains, supporting landholders to improve both the biodiversity and the productivity and simplifying the certification of sustainability (DCCEEW 2023a).

Lessons learned from the pilot schemes were incorporated into the design of the proposed Nature Repair Market. The Australian Parliament accepted the Nature Repair Bill in 2023. The total amount available for Nature Repair Market projects is A$8 million (DCCEEW 2024). The Nature Repair Market sets a framework for the world's first national, voluntary, legislated market that will enable private finance to help to repair and protect the natural environment and reward landholders for biodiversity protection. A National Stewardship Trading Platform has been established for this purpose. The platform is still under development, pending detailed market arrangements carried out in 2023 and early 2024. The department is working towards implementing the market in close consultation with First Nations organisations, NGOs, ecologists, environmental market participants and others (Australian Government 2023; DCCEEW 2023b).

2.2.6 New York City Watershed Program

Location: US, North America

Ecosystem type: urban, forest and agricultural

Mitigation hierarchy: minimise, restore

Key stakeholders
Lead and source of funding: New York City
Beneficiaries: farmers, forest owners
Intermediaries: US Environmental Protection Agency, New York City Department of Environmental Protection (DEP), Watershed Partnerships and Protection Council (WPPC)
Government role: program is run by a local government, with the US Environmental Protection Agency (EPA) as an intermediary.

Duration: ongoing since 1997

Summary
The New York City Watershed Program aims to protect the source of drinking water by protecting the New York City watershed from pollution. This is carried out by acquiring land and long-term contracts with farmers and forest owners in the surrounding watershed area. The contracts set limitations on land use and landowners are compensated for the changed value of the land. They may, for example, set protection zones around streams or prohibit construction on forested land.

1) What is the New York City Watershed Program?

The New York City watershed is the largest unfiltered system of water supply in the United States and provides nine million New Yorkers with about 1.3 billion gallons of clean drinking water daily (NYC 2011). The watershed covers about 5,200 square kilometres and extends 200 km north and west of New York City, and includes 19 reservoirs. It is also home to nearly one million inhabitants (NYC 2023). The watershed protection has saved money since the construction of a filtration plant has been avoided. The New York City Government has estimated that the savings are at least $10 billion (NYC 2024).

The city has used $541 million to protect its unfiltered drinking water under the Land Acquisition Program (LAP). The LAP acquires land and draws up contracts for long-term conservation easements with farmers and forest owners in the surrounding watershed area. The programme was initially prescribed in the 1997 New York City Watershed Memorandum of Agreement, and is still ongoing. As part of the Memorandum of Agreement, several Watershed Protection and Partnership Programs were established in the form of a Watershed Partnerships and Protection Council (WPPC). This way, the New York State Department maintains partnership programmes with the municipalities in the watershed (WPPC 2023).

2) How the economic mechanism works

The Watershed Agricultural Council (WAC) works with farmers and forest owners to maintain the water provision services in the watershed. The WAC employs three schemes to address water pollution problems, namely whole farm plans, forest-management plans and conservation easements (CEs) (Watershed Agricultural Council 2023).

CEs are voluntary legal agreements that permanently restrict land use on private properties in the drinking water conservation catchment area. They are funded by the New York City Department of Environmental Protection (DEP) and contracts are made between landowners and qualified conservation organisations. Property and inheritance rights, use of the land or right to sell remain with the landowner. The CEs also restrict certain rights or place conditions on certain uses for future generations. For instance, they can limit the right to subdivide or develop the property. However, easements can allow continued intensive commercial activities such as agriculture, timber harvests and blue stone quarrying so long as they are approved by the WAC. CEs are meant to provide economic benefits to both the landowner and the community via economic activities and livelihoods. Conservation easements are most commonly either sold or donated by a landowner to a qualified conservation organisation (land trust or government agency). This organisation holds stewardship over the land, which includes monitoring, landowner relations, record-keeping, processing landowner notices, amendment requests, managing stewardship funds, enforcement and legal defence. The Deed of Conservation Easement is a legally binding document registered with the county in which the property is located (Watershed Agricultural Council 2023).

Payments are based on the land's fair market value. If there is a record of sales of easements comparable to the site, the fair market value is based on these. In cases where there is a lack of comparable sales, the fair market value is calculated as the difference between the fair market value of the property before the granting of the restriction on land use, compared with after the granting of the restriction. The value before the conservation restriction must consider the current use of the property and the potential for development. The appraisal of the property value after the conservation restriction considers the effect of restrictions on the value of land (26 CFR § 1.170A-14 2024).

The Watershed Agricultural Council also works with farmers and forest owners to develop farm and forest-management plans. Whole farm planning is a holistic approach to farm management used to identify and prioritise environmental issues on a farm without compromising the farm business. Potential risks to the water supply are identified and addressed through careful structural planning to reduce or avoid agricultural run-off into farm streams. A farmer signs a voluntary participation agreement with the WAC. Renumeration for the cost varies between regions: in the Catskill/Delaware watershed, the DEP pays 100% of the cost to create and implement the plan's recommendations. In the Croton watershed, landowners themselves contribute up to 50%, depending on the cost guidelines, but there is also supplementary financing available for landowners.

For forest owners, funding is available under the Management Assistance Programme (MAP), which provides financial assistance and technical support to landowners who wish to conduct certain stewardship activities. Landowners who have a Watershed Forest Management plan or have completed a MyWoodlot profile are eligible for MAP. Watershed management plans are drawn up together with landowners and technicians to incorporate best management practices for water protection. MyWoodlot is a freely available, self-directed, online educational tool for owners of any amount of woodland. Stewardship or management activities include tree planting,

riparian improvement, invasive plant control or wildlife improvement. This is a competitive grant programme with monthly rounds. Maximum funding for stewardship activities is approximately $3,000 per grant round, and $6,000 per year per applicant (Watershed Agricultural Council 2023).

3) Lessons learned

The New York City Watershed Program has been able to protect New York's water supply by maintaining water provision services in its watershed. According to an assessment report water quality improved considerably between the early 1990s and 2020 (National Academies of Sciences, Engineering, and Medicine 2024). For example, the dissolved phosphorous load has decreased by a third (Sapienza and Rush 2021). It also contributes to biodiversity protection by protecting valuable riparian environments and maintaining forest and agricultural land uses (Watershed Agricultural Council 2023).

In tandem with improving surface-water quality, the implementing organisation, the WAC, supports the economic viability of agriculture and forestry in the watershed region. The best management practices of whole farm plans or forest-management plans alongside land conservation techniques and team planning are tailored to that farming or forested property (Watershed Agricultural Council 2023). The programme also provides opportunities for recreation, with areas within the watershed open for hunting, fishing, hiking and trapping (NYC 2011).

The New York City Watershed Program has been internationally recognised as a success story of payments for ecosystem services. The WAC (2023) attributes the success of the watershed programme to the following factors: 1) voluntary landowner participation within the watershed; 2) the organisation is locally controlled through the non-profit structure; 3) water-quality recommendations in the whole farm and forest-management plans are funded by the New York City Department of Environmental Protection, the U.S.D.A, the U.S. Forest Service and other funding sources; 4) strong advisory services on water protection measures; and 5) maintaining the economic viability of agriculture and forestry in the watershed.

Similarly, conservation easements placed on watershed farms and woodlands ensure working landscapes are protected for future generations. Strong agriculture-focused and forestry-based industries bolster the local watershed economy. The natural environment, complemented by the WAC's water-quality protection programmes, not only serves a function as New York City's watershed but also supports local access to nature and food production (Watershed Agricultural Council 2023).

An assessment report by the National Academies of Sciences, Engineering, and Medicine (2024) states that the different components of the watershed programme are well balanced in general. However, expenditures in the Land Acquisition Programme should be reduced to fund other programmes, such as agricultural and forestry programmes, that will lead to more direct improvements in water quality. The Land Acquisition Programme contributes very little to drinking water quality, but it has negative effects on community vitality (National Academies of Sciences, Engineering, and Medicine 2024)

Climate change with raised precipitation levels increases the pressure on watershed management. The assessment report highlights the need for better databases and data analysis to track the performance record of different watershed management procedures under the current climate change trends (Sapienza and Rush 2021).

2.3. Voluntary solutions in the private sector

2.3.1 Valio's sustainability programme

Location: Finland, Europe

Ecosystem type: agricultural

Mitigation hierarchy: avoidance, minimise, restore

Key stakeholders
Lead and source of funding: Valio Ltd, an international co-operative of Finnish dairy farmers that produces dairy products for national and international markets
Beneficiaries: Valio's contract farmers
Government role: no government intervention

Duration: ongoing since May 2023

Summary
As part of Valio's sustainability programme, Valio's contract dairy farmers have been able to claim an extra cent for biodiversity or climate measures associated with the milk they produce from May 2023 onwards. The measures include organising year-round grazing, establishing a biodiversity field that benefits pollinators, carrying out carbon farming measures or cultivating multi-species grass.

1) What is the Valio sustainability programme?
Valio is a company owned by approximately 3,700 Finnish dairy entrepreneurs through co-operatives. Their sustainability programme began in 2021, and all Valio farms have committed to improving animal welfare and receive a supplementary responsibility payment of 2 cents per litre of milk. In May 2023 the programme was reformed and the scope extended to enhance climate action, biodiversity and cow outing The measures contained within the new responsibility programme are voluntary for the farms, and each farm can select suitable measures to reduce the climate effects of milk production and to increase biodiversity (Valio 2023a).

With the new programme, farms receive an extra cent per litre of milk by carrying out selected measures, for example organising year-round grazing, establishing a biodiversity field that benefits pollinators, carrying out carbon farming measures or cultivating multi-species grass (Valio 2023a).

The programme aims to maintain and enhance biodiversity as well as the soil and pollination activities of dairy farms. A special focus is placed on increasing grazing that has biodiversity benefits like enhancing the invertebrate and bird populations, increasing the diversity of grassland species, increasing the number of flowering plants on farms and managing traditional semi-natural agricultural areas (Valio 2023a).

2) How the economic mechanism works
In addition to the sustainability premium of 2 cents per litre of produced milk for animal welfare measures, Valio now pays an extra cent per litre for the new sustainability measures to its contract dairy farmers. The farmers can collect an extra cent by choosing

from a diverse set of measures, which include grazing, setting up a diversity field, managing a traditional biotope or a natural pasture and carbon farming (Valio 2023a).

The average producer price for milk was about 52 cents per litre in August 2023 (LUKE 2023). For a dairy farm with 45 cows, the existing sustainability premium is about €8,000 per year. Under the updated mechanism that considers biodiversity actions, the same farm would receive around €12,000 per year if it satisfies all of the new criteria (Valio 2023a).

Farms choose the measures they want and can implement and receive a total of 0.1-1.0 cents of sustainability premium based on the selected measures. To qualify for the full additional cent, a farmer needs to choose several measures. The value of each measure is weighted, for example according to the associated workload. Farmers can choose more measures than are needed to obtain the full cent, but they will not receive a premium in excess of the 1-cent supplement. If the farmer does not implement the measure chosen, the additional payment for that measure ceases. Selections of measures are made once per year, and the farmers can change the measures they implement annually (Valio 2023b).

3) Lessons learned

Valio's sustainability programme started with a focus on animal welfare. It has been a success since all Valio's contract farmers have joined it. It means that about 80% of the milk produced in Finland is covered by Valio's responsibility programme. In addition to this, 86% of Valio's contract farms have joined the new programme that considers biodiversity (Valio 2023a; Valio 2023b).

The programme's success is monitored by tracking the number of farms participating and the hectares covered. The system is largely based on the farmer self-monitoring. In addition to self-monitoring, about 20% of the premises are visited each year to ensure that the producer acts in accordance with its commitments. It is, however, too early to evaluate its success since it is still a relatively new scheme (Valio 2023b).

The estimation of biodiversity impact of the programme is based on the measures carried out on the farm. A system for monitoring impact is currently under development. Various measures included in the programme produce multiple benefits. For example, grazing enhances both biodiversity and animal welfare and many carbon farming techniques also increase biodiversity. Grazing is also culturally and historically important, especially in old agricultural environments.

Valio's sustainability programme has the potential to have a positive impact on biodiversity. The large coverage of Valio's contract farms helps increase the potential impact of the scheme. A potential risk is that there is currently no third-party verification in place. Another issue that might introduce risk is how the weighting of the value of each measure is not transparent and may be based on subjective judgement. Since the impact monitoring system is not yet in place, the reliance on self-monitoring may lead to overestimating the positive impacts and underestimating challenges.

This case demonstrates how Valio employed a price premium and how such a mechanism has good potential to be applied in other companies selling consumer products or services. Valio's programme cannot be directly applied within other sectors, with the details needing to be adjusted to each product category and type of relationship with producers.

2.3.2 Fair to Nature certification system

Location: UK, Europe

Ecosystem type: agricultural

Mitigation hierarchy: minimise, restore

Stakeholders
Lead and intermediary: Royal Society for the Protection of Birds (RSPB)
Source of funding: businesses pay an increased price to farmers for Fair to Nature certified products. Consumers who can choose to buy certified products.
Beneficiaries: farmers
Government role: no government intervention

Duration: Ongoing since 1985

Summary
Fair to Nature is a biodiversity certification system for farms in the United Kingdom. Farmers who join the system dedicate at least 10% of their farmed land to managed habitats that have been proven to reverse wildlife decline. Certified farms receive a better commodity price for their harvest based on a better contract price paid by the food brands. The original certification system was created in 1985 and the system has developed as knowledge and experience has accumulated.

1) What is the Fair to Nature certification?

Run by the UK's largest wildlife and conservation charity, the RSPB (Royal Society for the Protection of Birds), Fair to Nature is the only UK certification scheme with a focus on biodiversity and a proven approach to restoring the balance of nature in farming (Fair to Nature Standard 2023).

Originally the certification only covered arable farms, but currently it includes all farm types in the UK. The certification system has been designed to address the loss of nature and critical ecosystems, which are essential to farming and will have a negative impact on food production in the long term. The loss of biodiversity is threatening land health, the longevity of farming businesses and the stability of supply chains. For example, farmland birds and pollinators are experiencing a drastic decline in the UK, and many food crops rely on pollinators. The loss of biodiversity is partly due to agricultural practices, so making changes in farms that will restore and enhance biodiversity is a necessary part of the solution. This scheme provides a way for farmers to undertake biodiversity restoration and protection efforts cost-efficiently (Fair to Nature Standard 2020; Fair to Nature Standard 2023).

The scheme allows for two levels of farmer membership: foundation and full members. Foundation members commit to meeting the Fair to Nature Standard within five years and full members within two years. There are habitat assessments every two years for all Fair to Nature members in which the quality of the wildlife habitats, their management and the benefits to wildlife are assessed. Fair to Nature also provides on-farm environmental advice if needed. Full members of Fair to Nature are audited

every two years using the Fair to Nature Standards, which includes a checklist of audit questions and required measures, including provision of appropriate documentation and evidence. The members also receive practical guidance and training with biennial assessments (Fair to Nature Standard 2020; Fair to Nature Standard 2023).

The target for farmers is to dedicate at least 10% of their farmed land to managed habitats that have been proven to reverse wildlife decline: 4% flower-rich habitats (minimum), 2% seed-rich habitats (minimum), 1% wildlife-rich boundaries and margins, one wet feature (approximately 25 m^2) per 100 hectares. Flower-rich habitats refer to wildflower-rich grasslands or areas dedicated to preferably native wildflowers around the farm. Seed-rich habitats refer to areas in which specific wild bird seed mixes have been sown, leaving areas unharvested or retaining winter stubble to help seed-eating birds survive the winter. Wildlife-rich boundaries and margins refer to grass margins, ditches or field corners where a varied structure is maintained to support a diverse range of species and where pesticides and fertilisers are not used in order to protect wildlife (Farm Wildlife 2024). The farmed land includes all crops, grassland, other grazed habitats (such as moorland or heathland), field boundaries and woodland created since 1992. It excludes roads, tracks, buildings and woodland that existed before 1992 (Fair to Nature Standard 2020).

Fair to Nature also supports regenerative agriculture practices through the inclusion of farm management plans for carbon reduction, water protection and nutrient management (Fair to Nature Standard 2020). In addition to dedicating 10% of the farmed land to wildlife-rich habitats, farmers are required to conserve priority species and habitats, restore soil structure, enhance organic matter, minimise the use of inorganic nitrogen and other fertilisers, minimise the use of pesticides through progressive integrated pest management, adopt the integrated management of livestock parasites, minimise the use of water and energy and undertake regular carbon audits (Fair to Nature 2024)

2) How the economic mechanism works

The RSPB manages the Fair to Nature Standard. The RSPB evaluates and audits the farms to ensure that the requirements are met. Food brands, suppliers and retailers can join the standard, and the RSPB then connects them with farmers who produce the products needed by businesses. This way businesses can stock products with validated sustainability claims that customers demand.

Businesses pay a higher price for the quality and reliability of sustainability claims for purchased products. Farmers receive a higher price for their product when they meet the conditions of the standard and have reliably passed the assessment included in the standard. Food brands and businesses can display the Fair to Nature logo on packages, which ensures that consumers can make informed choices on spending their money supporting nature values on farms (Fair to Nature Standard 2023; Birch 2023).

3) Lessons learned

There are currently about 20,000 hectares of Fair to Nature certified farmland, which represents approximately 0.11% of all agricultural land in the UK (Fair to Nature Standard 2023; Statista 2023). The farmland delivers bird seed, grain and other certified products such as lavender, lettuce and rapeseed oil. These Fair to Nature certified lands are also beneficial for pollinators and predators of crop pests, which decreases the need for pesticides.

On the RSPB's own Fair to Nature certified farm, which was purchased by the RSPB in 2000 and which now produces seven different crops in rotation, there has been a 226% increase in breeding birds and a 213% increase in farmland butterflies. The floral diversity has doubled and there are 19 times

more bees than on typical farmland (Fair to Nature 2024).

The Fair to Nature scheme is designed to be coherent with environmental support schemes provided by the government. By meeting the standard's requirements, farmers can also become eligible for these government schemes, which might be beneficial for them. Farmers also receive knowledge transfer and support from other Fair to Nature members (Fair to Nature Standard 2020).

The Fair to Nature's certification system is an efficient way to improve agricultural ecological outcomes, especially if the current government environmental support schemes do not provide enough of an incentive to motivate farmers. Certification systems can also be designed to complement these existing support schemes.

2.3.3 Rudus biodiversity programme

Location: Finland, Europe

Ecosystem type: multiple

Mitigation hierarchy: net gain

Key stakeholders
Lead: Rudus, a company. It works closely with multiple stakeholders, for example experts and organisations such as environmental non-governmental organisations and local organisations.
Government role: no government intervention

Duration: ongoing since 2012

Summary
Rudus is a company that produces building materials. The goal of their biodiversity programme is for nature to be more diverse and valuable at their facilities when operations cease compared to when they began. The programme creates new and sustainable methods for excavation, restoration in soil extraction areas and in the vicinity of industrial plants. The programme also includes areas following aggregate extraction activities, as they can be transferred into habitats for both ordinary and endangered species (Rudus 2023).

1) What is Rudus's biodiversity programme?
Rudus is a company producing building materials like concrete. In 2012, Rudus began a programme to actively promote biodiversity. The company has carried out several voluntary biodiversity compensation pilot projects in agreement with authorities. The company has, for example, implemented an ecosystem hotel pilot scheme in Raasepori, along highway 25, where the transfer of entire ecosystems to a new location was tested during a road construction project. Another example is an old gravel extraction site located in Porvoo that contained cloaked frogs (*Rana arvalis*), which are protected in Finland. The extraction site included a pond, which the frogs use for reproducing and which was suffering from an overgrowth of vegetation. In order to protect the frogs, the company has constructed additional ponds and is studying the migration of the frogs to them. The work has improved the habitat as the population is now growing instead of declining. As a result, Rudus was granted permission to continue gravel extraction operations at this site (Tynkkynen and Berninger 2017; Centre for Economic Development, Transport and the Environment 2022).

The scarce fritillary (*Euphydryas maturna*), a strictly protected butterfly species, exists at the Sipoo site where Rudus is planning to extract gravel. A solution was reached with the authorities for the establishment of compensation areas outside the project area. It would have been possible to apply for an exemption permit under the Nature Conservation Act or to wait until the species had disappeared from the site in order to start operations, but Rudus decided to take action to conserve the species

instead. A conservation plan was drawn up for the species in 2017, which included a transfer plan for the butterflies to an environment better suited to them. The first transfer of butterfly nests was executed in 2020. In 2022, 36 butterfly nests were successfully transferred. Without these measures, it is likely that the butterfly would have been lost to the site as a result of the continued overgrowth of vegetation. Rudus maintains a plan to restore habitats for the scarce fritillary to at least double that of the current size within the project area. Rudus acquired a permit to continue excavating gravel at the Sipoo site in 2019 (Tynkkynen and Berninger 2017; Rudus 2023).

Another example is the gravel extraction site at Ryttylä in Hausjärvi, which was part of the biodiversity programme. The area harbours numerous endangered insects and plant species and measures have been taken to control the spread of invasive species (such as the Russell lupine). In 2017, the area was sold to the Vuokko nature conservation organisation for a nominal price of one euro, and the organisation committed to maintaining the area for 20 years (Vuokon luonnonsuojelualue 2018).

Through its biodiversity programme, Rudus aims to promote the preservation of Finnish biodiversity and its ability to adapt to climate change. The biodiversity programme has been expanded to include assessments of the environmental impact within supply chains. Additionally, the biodiversity programme seeks to enhance carbon sequestration and thus contribute to mitigating climate change (Tynkkynen and Berninger 2017).

2) How the programme works

The work of the biodiversity programme has been executed mostly with existing resources from within Rudus. The programme has been integrated into the everyday work of the company, staff have been educated and the work carried out with company machinery so no additional purchases have been needed (Rudus 2023).

Rudus's biodiversity programme is a voluntary project, but there is an indication that some of the programme measures have helped to obtain permits or have paved the way to obtaining permits for their projects. For example, the improved habitat for the cloaked frogs was an important factor in the decision not to request a new environmental impact assessment before applying for permission to start excavating gravel (Centre for Economic Development, Transport and the Environment 2022).

3) Lessons learned

Rudus has demonstrated that with relatively small investments, certain companies can deliver positive impacts for biodiversity. The biodiversity programme had high-level commitment from the beginning, which has been essential for its success. One key to the success was that the programme was integrated into the firm's everyday work by educating its employees. There has also been significant co-operation with stakeholders such as environmental NGOs, municipal authorities and local experts, which has been important for ensuring the success of the programme. One identified issue, however, concerns how sites that have undergone restorative action can continue to be maintained after Rudus has handed over ownership (Rudus 2023).

2.3.4 The World Bank Wildlife Conservation Bond

Location: South Africa, Africa

Ecosystem type: savanna, bushveld and dryland forests

Mitigation hierarchy: restore

Key stakeholders
Lead: the World Bank (International Bank for Reconstruction and Development)
Source of funding: institutional and private investors; the Global Environment Facility (GEF) funds the potential performance payment
Beneficiaries: the Great Fish River Nature Reserve and Addo Elephant National Park
Intermediaries: independent parties Conservation Alpha and the Zoological Society of London will verify the rhino growth rate and therefore the success of the investment/conservation
Government role: no government intervention (apart from GEF financing)

Duration: 2022-2027

Summary
The World Bank Wildlife Conservation Bond is a mechanism supporting the conservation of black rhinos in South Africa through a principal-protected outcome-based bond. This financial instrument operates by having investors accept the risk associated with project outcomes in exchange for a potential payout if the project proves successful. This innovative approach highlights the potential for integrating private resources to advance environmental objectives.

1) What is the World Bank Wildlife Conservation Bond?

Black rhinos (*Diceros bicornis*) are considered an umbrella species in Africa, playing a pivotal role in the ecosystem. However, due to the threats of poaching and habitat degradation, they are now classified as critically endangered. Black rhinos are slaughtered for their horns, which are in demand in international markets. The primary goal of the scheme is the conservation of the black rhino habitat and its ecosystem, with success measured by an increase in black rhino populations. This case study is an example of how private investments can promote biodiversity conservation (World Bank n.d.).

With the rhino bond, conservation activities include measures to secure water availability for black rhinos and to improve rhino security through national park staffing and better facilities, and therefore reduce poaching. Some of the financing also contributes to improving co-ordination between the national and regional levels. These conservation activities also include improving the management of over 150,000 hectares and providing over 2,000 jobs for local communities in and around both natural parks (World Bank n.d.).

The work on the World Bank Wildlife Conservation Bond commenced with the development of the Rhino Impact Investment Project. The primary funding for this project came from the Global Environment Facility, with additional contributions from Conservation Alpha, Fauna and Flora

International, Kenya Wildlife Service, The Nature Conservancy, USB and WWF, each providing legal and technical conservation and conservation finance support. Rhino Impact Investment conducted a comprehensive three-year study to assess the feasibility of outcomes-based financing for rhino conservation (Green Finance Institute n.d.).

Subsequently, with the assistance of Credit Suisse, they pioneered the world's first "pay-for-results" financial instrument dedicated to species conservation. Credit Suisse played a pivotal role as the sole structurer of the World Bank Wildlife Conservation Bond, later sharing book-running responsibilities with Citibank. This new approach represents an advancement in utilising financial mechanisms to support and incentivise concrete outcomes in the field of wildlife conservation (World Bank 2022a).

2) How the economic mechanism works

The World Bank Wildlife Conservation Bond has been assigned a credit rating of AAA by S&P Global Ratings, indicating a strong creditworthiness. The bond has collected $150 million since its issuance in 2022. When investors choose to invest in the bond, their principal is protected. The success payment is contingent on the black rhino population's growth rate, reflecting the degree of success of conservation efforts. The funding for success payment is provided by the Global Environment Facility (GEF), while the financing for conservation efforts is sourced from bondholders (World Bank n.d.).

Bondholders are eligible to receive a conservation success payment determined by the net rhino population growth rate. In the absence of any change, no success payment will be issued. If the net rhino population increases within the range of 0 to 2%, bondholders will receive a 3.7% return. For a net rhino population growth rate between 2 and 4%, bondholders will receive a 7.3% return. If the net rhino growth rate exceeds 4%, bondholders will receive a 9.2% return (World Bank 2022a).

In addition to the considerations related to rhino population net growth, bondholders will also receive their principal investment back at maturity from the World Bank. Sales from the notes are invested in the World Bank's treasury and the principal investment is paid from the treasury funds. The incorporation of a success payment tied to conservation outcomes effectively transfers some project risks to investors and enables donors to remunerate based on achieved conservation results (World Bank 2022a).

3) Lessons learned

The World Bank Wildlife Conservation Bond was initiated in 2022; thus, there is currently no available economic or ecological evaluation. However, potential co-benefits have been identified, such as the role of rhinos as an umbrella species, signifying that their conservation positively impacts the entire ecosystem and other species cohabiting in the same habitat. Conservation measures within natural parks also contribute to the protection of carbon sinks and water catchment areas. These protected zones play a crucial role in mitigating the adverse effects of climate change and serve as a buffer against extreme conditions. Furthermore, the project generates employment opportunities for the local community, acting as a catalyst for economic development.

The World Bank (2022b) has identified several challenging conservation issues, encompassing potential threats such as illegal poaching, diseases and issues related to the overpopulation of large mammals that could influence the rhino growth rate. Risks associated with socio-political conflicts may emerge in the event of a breakdown in relationships between parks and local communities or with the local, regional or national government. Such conflicts have the potential to affect the rhino population and jeopardise the acceptability of the project. Land claims pose another potential threat, especially if local communities can

substantiate previous claims of occupation and wrongful displacement. While communities typically maintain ownership of their land for conservation purposes, the emergence of land claims introduces a potential risk to the overall success of the project (World Bank 2022b). Therefore, engaging in co-operation with local communities and ensuring clear communication about the project is vital.

The risks related to the economic mechanism include the verification of the black rhino growth rate. Errors in calculation or inadequate data monitoring could affect the accuracy of the project's evaluation and the success payment. Consequently, it is important that the monitoring is done by a reliable third party, because the success payment is vital to the investors. The World Bank (2022b) has identified the complexity of the bond instrument as a potential risk. There is a concern that investors may face challenges in understanding the associated risks and intricacies of the mechanism, leading to potential misunderstandings. Noteholders whose economic activities take place in a currency other than US dollars might also experience a currency exchange rate risk (World Bank 2022b).

2.4. Other mechanisms

2.4.1 Quintana Roo coral reef insurance

Location: Mexico, North America

Ecosystem type: wetlands, coastline reef

Mitigation hierarchy: avoidance, restoration, net gain

Mechanism of revenue generation: other, parametric insurance

Key stakeholders
Lead: the State Government of Quintana Roo and the Nature Conservancy
Source of funding: taxes paid by property owners, government funding, philanthropic grants
Beneficiaries: the hotel and tourism industry, financial and reinsurance industry, local inhabitants
Intermediaries: Quintana Roo's Coastal Zone Management Trust (CZMT), Swiss Re Foundation, Mexico's National Commission of Natural Protected Areas
Government role: the State Government of Quintana Roo is the lead together with various stakeholders

Duration: ongoing since 2018

Summary
In 2018, the Quintana Roo State Government together with several stakeholders launched a programme to purchase a parametric insurance policy for part of the Mesoamerican Reef. The reef attracts thousands of tourists each year and protects coastal infrastructure from hurricane damage. Hurricanes damage also reefs and quick action is needed to avoid the dying out of corals. The parametric insurance ensures quick payments when wind speeds reach or exceed 90 knots within 60 kilometres of the reef.

1) What is the Quintana Roo coral reef insurance?
The Mesoamerican Reef is the second-longest barrier reef system in the world and one of the most diverse ecosystems on the planet. These hotspots of biodiversity support more species per unit area than any other marine environment. They provide habitat for numerous fish species, many of them important for fisheries. This diverse ecosystem attracts thousands of tourists each year and provides the Mexican Caribbean coastline with protection from storm surge and tides, thereby bringing significant economic benefits to Mexico's tourism and communities. Studies indicate that the reef can reduce wave energy by up to 97%, and losing one metre in reef height is estimated to triple damage costs. The reef is estimated to mitigate annual damage costs to buildings by US$42 million, including about US$20 million annual damage costs to local hotel infrastructure caused by storms and coastal

erosion (Nature Conservancy 2018; Nature Conservancy 2021; Visser et al. 2023).

Storms affecting the Mexican coastline can damage the reef and therefore reduce its capacity to provide protection. After a hurricane, damaged reefs need quick rehabilitation to avoid coral death. To address this, the State Government of Quintana Roo, together with the Nature Conservancy and Swiss Re, created the first parametric insurance solution to protect the coral reef. Parametric insurance operates in such a way that the insurance payout is agreed upon in advance and tied to a physical parameter reaching a pre-agreed target such as wind speed or drought level. Beneficiaries receive a quick payout when the parameter reaches the threshold without having to measure and report losses (Visser et al. 2023; World Bank 2020).

The insurance covers 400 km of coastline and several Mexican municipalities, including Cancún. The coral reef parametric insurance provides payment when wind speeds reach or exceed 96 knots within 60 km of the reef. Upon receiving the funds, a reef rehabilitation team that consists of local community members trained by the Nature Conservancy, starts assessing damage and rehabilitating the reef. This happens quickly since payments are made within one month of the event (Visser et al. 2023).

2) How the economic mechanism works

The policy holder, the organisation buying the insurance and receiving the payment in case an insured event occurs, is the State Government of Quitana Roo. The insurance covers tropical storms and the payout is tied to wind speed that is associated with category 1-5 hurricanes and the proximity of the reef. The parametric insurance provides proceeds if the wind is 96 knots or more within 60 km of the reef (40% is paid if the wind is 110 knots, 80% if 130 knots and 100% if 160 knots, based on the probability of occurrence of the wind speed). The scheme partners provide their expertise in insurance while the public policy holder minimises the risk for private businesses. The nature conservation protocols and the training activities are the responsibility of a team of 80 people who carry out the rehabilitation work (Nature Conservancy 2021).

The insurance premium, the fee paid for the insurance, is paid by Quintana Roo's Coastal Zone Management Trust (CZMT) that was established to collect funds from a fee paid by beachfront property owners, as well as other private and public sources, in order to manage the funds for reef maintenance and repair (World Bank 2020).

3) Lessons learned

The coral reef insurance protects the coral reef against damage associated with increased climate risk and at the same time maintains the valuable ecosystem services the reefs provide for local communities and the local economy (Visser et al. 2023). Hurricane Delta occurred in 2020 and a sum of US$760,000 was paid out from the insurance policy. The reef rehabilitation team was at work within one week. They transplanted more than 9,000 fragments of broken coral and helped to stabilise 1,200 coral colonies that were displaced (Visser et al. 2023).

The success factors of the Quintana Roo coral reef insurance include creating an enabling environment for innovative insurance solutions in Mexico, succeeding in involving a public body as a policy holder, involving nature and insurance experts in the product development, and putting in place mechanisms for risk sharing (Visser et al. 2023).

Parametric insurance are policies that pay out according to the severity of an event rather than the severity of losses. Thus, parametric insurance involves a "basis risk", which means that the payout may be either higher or lower than the damage inflicted. The basis risk can be managed by improved monitoring technologies for damage, as well

as risk modelling, and scenario analysis, which help to create a more realistic understanding of the expected damage costs and the insurance premium. A major challenge with the Quintana Roo parametric insurance has been that the premium has been reduced from its original level, resulting in lower coverage and increased exposure to risk. This is partially due to the Covid-19 pandemic, which affected revenues from tourism and significantly reduced the fees collected for the scheme (Green Finance Institute 2023, Visser et al. 2023).

The Quintana Roo coral reef parametric insurance model is the first of its kind, and despite the challenges it can be considered to be successful. The scheme also has potential for replication. The Mesoamerican Reef Fund has already adopted the model in other areas of the reef in collaboration with Willis Towers Watson, InsuResilience Fund and AXA Climate. Similar insurance solutions may also be designed for different ecosystems (Green Finance Institute 2023; Visser et al. 2023).

2.4.2 Insurance services and mangrove protection pilot scheme in the Philippines

Location: Philippines, Asia

Ecosystem type: wetlands

Mitigation hierarchy: avoidance, minimise, restore

Key stakeholders
Lead: Restoration Insurance Service Company (RISCO)
Source of funding: insurance companies (main source), investors, blue carbon credit buyers
Beneficiaries: service providers for restoration and conservation (RISCO itself or a third-party provider such as local community-based organisations)
Government role: local or national government can be a holder of carbon rights

Duration: ongoing since 2019

Summary
The Restoration Insurance Service Company (RISCO) is a social enterprise that aims to deliver mangrove protection and restoration by generating revenue through insurance-related activities focused on reducing property damage risk and by selling credits to generate blue carbon revenues. It identifies suitable sites, coordinates with local partners and the insurance industry, and helps the insurance sector evaluate the risk reduction benefits of the mangrove stands. The insurance industry pays a fee to RISCO for the valuation service and mangrove protection. RISCO invests this along with revenue from selling carbon credits from mangrove conservation and restoration work.

1) What is RISCO?
The Global Innovation Lab for Climate Finance developed RISCO as an innovative instrument that recognises revenue streams derived from mangrove conservation and restoration. It integrates the risk reduction value of mangroves into insurance products and monetises the climate mitigation potential of mangroves through blue carbon credits.

Mangroves provide valuable ecosystem services such as prevention of erosion, flood control and supporting fisheries. These are important for coastal communities and owners of coastal assets such as hotels and residential areas. Mangroves also provide ecosystem services for climate mitigation by storing large amounts of carbon and through adaptation to increased flood risks (Global Innovation Lab for Climate Finance 2019).

Mangroves are insufficiently protected as a result of insufficient financing from government, a failure to prioritise protection work and over-reliance on philanthropic finance. RISCO aims to overcome these barriers by connecting the benefits of mangrove protection to the beneficiaries of these values, such as local coastal communities and organisations, as well as insurance companies. Most of the beneficiaries do not have the knowledge or resources needed to protect mangroves, which is what RISCO aims to provide (Global Innovation Lab for Climate Finance 2019).

The aim of RISCO's initial pilot project is to conserve 3,400 hectares of mangrove forests and restore an additional 600 hectares. In addition to these benefits, the scheme is expected to reduce flood risks for 7,000 people, provide a climate benefit of more than 600,000 tonnes of avoided and sequestered CO_2 emissions, and generate more than US$10 million in revenue from the insurance sector and blue carbon credits in the next 10 years (Global Innovation Lab for Climate Finance 2019).

2) How the economic mechanism works

The insurance companies pay a fee to RISCO for helping with the valuation of mangrove benefits, and for continued, verified mangrove conservation or restoration. RISCO also receives funds from investors who invest in equity in RISCO and purchasers of blue carbon credits. Revenues are invested in mangrove restoration and protection, which improves coastal protection and biodiversity as well as stores carbon. Benefiting from reduced flood risks through the mangroves, the insurance sector offers insurance with reduced premiums to coastal asset owners.

In the short term, RISCO relies on a blended mix of grants from private foundations and bilateral aid organisations, equity from impact investors and loans from development finance institutions and multilateral development banks. In the longer term, RISCO aims to become self-financing with the insurance and blue carbon revenue streams. RISCO holds contracts with insurance companies or associations of insurance companies and aims to secure an annual payment from them for continued, verified conservation and/or restoration of mangroves. The annual payment will be linked to a site-specific calculation of the flood reduction benefits provided by the mangroves (Global Innovation Lab for Climate Finance 2019).

RISCO will engage directly or via a third-party provider (such as local community-based organisations contracted via a conservation agreement) who specialises in conservation and restoration activities. Conservation generally requires establishing agreements with adjacent communities to protect the mangroves, monitoring and enforcement, and development of alternative livelihoods to reduce the pressure on mangroves. Restoration requires mangrove nurseries and labour to plant mangrove seedlings, and sometimes restoration of the planting site (Global Innovation Lab for Climate Finance 2019).

Regarding the blue carbon credits, RISCO will generate and sell the credits and negotiate benefits-sharing agreements for the credit revenue. RISCO will utilise Verra methodologies for wetlands restoration and conservation to generate and sell blue carbon credits to organisations seeking to meet climate mitigation targets. In addition to securing initial financing, RISCO will identify viable project sites, coordinate and contract with insurance partners, provide the mangrove conservation and restoration interventions directly or via a third party and manage the process to generate and sell blue carbon credits. Those holding credits (for example project partners with Foreshore Lease Agreements or other legal tenures, or the government) will receive a fixed fee payment to secure their blue carbon rights. Additionally, they may negotiate a share of the blue carbon revenue, while allocating a portion to RISCO for the project's implementation (Global Innovation Lab for Climate Finance 2019).

The implementation of RISCO's model has three phases: 1) the pre-pilot scheme phase; 2) the implementation of the pilot scheme; and 3) replication. Phase 1 is financed by grant funding of approximately US$1.21 million. This allows RISCO to secure partnerships (with insurance companies, risk modelling experts or companies, or other local partners), engage in additional scoping and analysis, negotiate contracts with insurance companies and prepare a project design document for the generation of blue carbon credits.

Currently, the phase 2 project costs are estimated at US$5.69 million, of which US$2.35 million is for restoration investments and US$3.34 million is for operating expenditures, including ongoing conservation costs. This will be covered with a combination of debt and equity financing, both of which aim to be repaid via the insurance sector and blue carbon revenue streams. If phase 2 is successful, phase 3, which includes replication of the pilot scheme to other suitable sites and countries, will rely mainly on private domestic debt and equity finance (Global Innovation Lab for Climate Finance 2019).

3) Lessons learned

RISCO started its pilot phase in 2019 in the Philippines. The insurance products and business model are still under development and RISCO is establishing relationships with local insurance companies and coastal asset owners. The pilot project in the Philippines has faced a challenge with insurance premiums. The premiums were already very low in the country, which has prevented the reduction of the price of premiums based on conservation efforts. This has led to RISCO looking to secure US$10 million in annual fees from insurance companies that directly benefit from the increased protective functions of mangroves for insured coastal assets and US$10 million in blue carbon credits over 10 years. The annual payment is linked to a site-specific calculation of the annual flood reduction benefits provided by the mangroves. The raised fees will be used to fund community-based conservation and restoration activities directly linked to risk reduction (Earth Security Group 2020; Visser et al. 2023).

The implementation of the first phase of this pilot scheme was scheduled for 2019-2020, but because of the Covid-19 pandemic it did not progress as intended. In addition, there were also issues with availability of suitable locations. The idea behind this pilot project was to undertake restoration activities in the same area where the assets and industries that were experiencing flood risks were located, meaning those facing the risks would be willing to pay for the insurance. However, there were no longer mangroves to restore in those areas. The scheme also encountered problems with irregular cash flow, which led to problems with financing the restoration activities. In future efforts to combine biodiversity and insurance products, there should be a clearer link between insurance and a stable cash flow (personal communication with a source in the insurance industry).

RISCO could be replicated in Mexico, Malaysia, Indonesia and Brazil. This is based on selection criteria developed by RISCO, which state that possible areas for replication should include sufficiently large mangrove cover or potential for large areas of mangrove restoration, high potential for developing blue carbon credits, legal structures that allow for crediting, exposure to storms and flooding, a functioning and growing non-life insurance market, and people and assets located by the coast, protected by mangroves. If RISCO pursues projects in all these countries, it could generate over US$200 million in revenue and achieve avoided emissions and the sequestration of 16 million tonnes of CO_2 over a 10-year period (Global Innovation Lab for Climate Finance 2019; Global Innovation Lab for Climate Finance 2021).

RISCO's mangrove conservation and restoration efforts are expected to have significant positive impacts on biodiversity as well as on regulating services such as flood protection. There is, however, no information available on the extent of these impacts.

The key barriers to replicating the pilot scheme include identification of sites with sufficiently large mangrove cover to justify project development, selection of regions with sufficient insurance penetration and a sufficiently developed insurance market, and potential challenges associated with securing legal rights to blue carbon credits (Global Innovation Lab for Climate Finance 2019; Visser et al 2023).

2.4.3 Voluntary offsetting of land-use change in Espoo

Case study update
In 2022, the city of Espoo evaluated the possibility of using the establishment of a new conservation area as an offset to match for the impacts of building a data centre elsewhere in the city.

2023 marked the establishment of the Finnish Voluntary Ecological Compensation Scheme. As Espoo's initiative started before the scheme was established, the initiative did not follow the structure of the voluntary ecological compensation in Finland, for instance:

- That the entity causing nature loss is responsible for ensuring ecological enhancement happens elsewhere
- That activities producing enhancements should precede the degrading actions

Location: Finland, Europe

Ecosystem type, forest (temperate boreal) and woodlands

Mitigation hierarchy: offset

Mechanism of revenue generation: other, land property exchange

Stakeholders
Lead: City of Espoo
Government role: a project managed by a municipal government

Duration: The plan for development in the Hepokorvenkallio area was accepted in 2023.

Summary
The City of Espoo is seeking to address biodiversity and carbon storage loss from a data centre construction in Hepokorvenkallio by conserving the city-owned Hynkänlampi forest. The voluntary preservation of Hynkänlampi aims to achieve the dual purpose of contributing to the protection of biodiversity and acting as a carbon sink, while simultaneously enhancing the availability of recreational spaces for the community.

1) What is the voluntary development compensation in Espoo?
The Hepokorvenkallio ecological offset programme is a voluntary initiative aimed at mitigating the biodiversity loss of building a data centre for Microsoft in Hepokorvenkallio. Hepokorvenkallio is a city-owned, 19-hectare forest, which is mainly managed as a commercial forest. The City of Espoo has proposed the conservation of the city-owned, 79-hectare Hynkänlampi forest as voluntary ecological offset. The driving force behind this initiative is the City of Espoo's commitment to safeguard biodiversity and achieve an 80% reduction in carbon emissions from the 1990 level by 2030.

2) How the economic mechanism works
The Hepokorvenkallio project represents voluntary ecological offsetting by the City of

Espoo, which aims to counterbalance the biodiversity loss incurred from allocating land for a data centre in the Hepokorvenkallio area. The city is taking on the responsibility of bearing the cost and executing this project. Notably, the offset involves the preservation of the Hynkänlampi forest, an area already owned by the city, thus eliminating the need for explicit monetary exchanges.

3) Lessons learned

While the project has yet to commence, an assessment has been conducted by Espoo City Planning Department, indicating a favourable outlook for its success. Nevertheless, it is crucial to note that assessment was done by Espoo's own planning department, introducing potential biases associated with their perspective. According to the assessment, the preserved Hynkänlampi forest is not only larger but also holds a higher natural value compared to the Hepokorvenkallio forest. The value is calculated using habitat hectares, which reflect the diminishing area and its ecological significance from the perspective of biodiversity. In the diminishing forest area of Hepokorvenkallio, the calculated value is 7.6 habitat hectares, whereas the proposed conservation forest, Hynkänlampi, has a value of 30 habitat hectares. The Hynkänlampi forest is currently managed as a recreational forest. Thus, the conservation of the area will increase its nature value, but the assessment was not able to determine exactly how much the habitat hectares of Hynkänlampi forest will change after conservation (Espoo City Planning Department 2022).

The compensation effort has been planned according to best practices in the field (Moilanen and Kotiaho 2017). First, the project is designed to create added benefits beyond mere conservation, ensuring that the preserved Hynkänlampi forest serves as more than just a passive offset; restoration efforts are planned for the forest, contributing to its biodiversity. While the conserved Hynkänlampi forest is expected to evolve into a more natural state over time, conservation efforts will support and accelerate this transition. Furthermore, the principles emphasise matching of the benefits derived from the newly conserved area with the losses incurred in the original area. In addition to its habitat hectares, the Hynkänlampi forest aligns with the Hepokorvenkallio forest type, ensuring compatibility in compensation. In this case, both biodiversity and carbon sink losses are mitigated simultaneously (Espoo City Planning Department 2022).

Besides improving biodiversity and carbon sequestration, the conservation of Hynkänlampi will also offer other benefits. Hynkänlampi forest acts as a connecting bond between forest areas of Nuuksio and Oittaa. The expansion of recreational space enhances leisure opportunities for the residents of Espoo, thereby contributing to the overall well-being of the community (Espoo City Planning Department 2022).

However, a potential limiting factor has been identified in the form of spruce bark beetle infestations, which may necessitate logging and consequently delay the conservation of the forest. The assessment (2022) emphasised that careful planning and consideration are crucial when implementing ecological compensation. It is worth noting that Finland currently has limited voluntary ecological compensation programmes, underscoring the significance of actively engaging in research and evaluating best practices in this regard. A potential limiting factor is also the fact that the City of Espoo has not been able to report how much additional benefit stems from the planned conservation efforts (Espoo City Planning Department 2022).

One distinctive aspect of this initiative is the absence of a third party involved in the compensation process. Consequently, the decision by the City of Espoo to independently manage the offsetting raises questions about the project's reliability. To enhance transparency and accountability, it would be favourable to incorporate external monitoring by a third party into the project, ensuring the reliability and success of this self-funded ecological offsetting.

2.4.4 Hamburg Green Roof Strategy

Location: Germany, Europe

Ecosystem type: urban

Mitigation hierarchy: restore

Stakeholders
Lead: City of Hamburg
Source of funding: Hamburg's Ministry for Environment, Climate, Energy and Agriculture, the EU Horizon 2020 programme and the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety
Beneficiaries: building owners or construction companies
Government role: partly funding this project

Duration: 2014-2024

Summary
The Hamburg Green Roof Strategy is an initiative with the goal of transforming the city into a greener urban environment. The strategy aims to combine the numerous advantages of green roofs, including enhancing biodiversity and water retention, and creating leisure areas for residents. This is accomplished by partly subsidising the green roof installation costs for building owners and construction companies.

1) What is the Hamburg Green Roof Strategy?
The Hamburg Green Roof Strategy is driven by the city's aim to enhance its green infrastructure, given the constraints of limited space in a densely populated urban environment. This aligns with Hamburg's vision of transforming itself into a climate-friendly and resilient city while accommodating urban growth. This, in part, will be achieved through the ability of green roofs to offer ecosystem services, such as biodiversity and improved water retention.

The primary objective of the strategy is to establish a total of 100 hectares of green roofs, covering approximately 70% of new buildings and suitable flat roof areas in Hamburg. The City of Hamburg employs various methods to promote the implementation of green roofs. One of the most crucial approaches involves an economic incentive, which allows building owners to receive subsidies for constructing green roofs. The main stakeholders in this initiative are the City of Hamburg, collaborating with housing estate companies, construction companies, landscape architects and urban planners (Climate-ADAPT 2023).

2) How the economic mechanism works
Funding for the Hamburg Green Roof Strategy primarily comes from Hamburg's Ministry for Environment, Climate, Energy and Agriculture. Additionally, financial support is provided by the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety as part of their "Measures for adaptation to climate change" programme. The Hamburg Green Roof Strategy has also received funding from the EU as part of the Horizon 2020

"CLEVER Cities" programme (Climate-ADAPT 2023).

Building owners and construction companies can receive subsidies covering 30 to 60% of the installation costs for green roofs, with a maximum limit of €50,000. The subsidy amount varies based on the thickness and surface area of the green roof. Additional subsidies are available for inner-city locations, use for solar energy or if the roof is accessible to multiple users (Climate-ADAPT 2023).

Launched in 2014, the Hamburg Green Roof Strategy is set to receive financial support until the end of 2024. However, the benefits derived from green roofs continue as long as the roofs remain in service, which has been estimated at being twice as long as conventional roofs (Free and Hanseatic City of Hamburg and Ministry of Environment and Energy 2017).

3) Lessons learned

During the project's lifetime, 44 hectares of green roofs were constructed, bringing the total green roof area in Hamburg to 168 hectares. An economic evaluation conducted in 2017 found that the construction cost for extensive green roofs is approximately €40 to €45 per square metre, while intensive green roofs cost approximately €58 per square metre. Intensive green roofs typically include perennials, grasses, bulbs, summer flowers and shrubs, and in individual cases, trees and lawns. Extensive green roofs consist of plants that are self-maintaining and self-propagating, resulting in lower costs compared to intensive green roofs. The study shows that, over a 40-year period, the overall costs of traditional roofs and green roofs are comparable. Although building green roofs is more expensive upfront than traditional roofs, the latter require more frequent renovation, making the long-term costs comparable (Free and Hanseatic City of Hamburg and Ministry of Environment and Energy 2017).

While the economic evaluation did not quantify monetary benefits, from a building owner's perspective green roofs offer more insulation, thereby lowering heating costs in winter and reducing cooling costs in summer. Additionally, they can offer extra green space for leisure. In the case of Hamburg, green roofs contribute to improved biodiversity, water retention and air quality, while also decreasing the urban heat island effect. In the long run, these benefits positively influence the well-being of Hamburg's residents and align with the city's sustainability goals (Free and Hanseatic City of Hamburg and Ministry of Environment and Energy 2017).

The success factors identified for the strategy include effective communication and the sharing of knowledge among scientists, stakeholders and policymakers. One limiting factor is the potential health hazards related to seagull breeding on green roofs. This may negatively impact the public perception of green roofs, underscoring the need to communicate both the benefits and risks associated with them. Another challenge is the limited awareness of construction costs among construction companies, leading to a reluctance to invest in green roofs caused by the perceived high expense. Continued commitment to monitoring, communication and addressing the identified limiting factors can further enhance the long-term success of the Hamburg Green Roof Strategy (Free and Hanseatic City of Hamburg and Ministry for Environment and Energy 2017).

3. Assessment of mechanisms and their suitability for Finland

All mechanisms could be applied in Finland with certain limitations. The suitability depends on how the mechanism is designed. The key success factors identified in the study include production of co-benefits, building trust and acceptance by landowners and the local community, and that a trusted and credible organisation manages the mechanism and ensures positive biodiversity impacts.

3.1. Each mechanism has pros and cons

Based on the case study findings, the key features of the different mechanisms are presented in Table 1. These key features are the source of funding, role of government, generation of funds for environmental activities, basis for payment and the potential for scaling.

Regarding the source of funding, the mechanisms complement each other. Some rely primarily on public funding, while others depend on private funding from citizens or companies, thereby expanding the availability of funding for environmental activities.

The government plays an essential role in PPP and PES by establishing environmental goals, legislation or programmes and overseeing the implementation, monitoring and evaluation of the processes and impacts of the scheme. In voluntary mechanisms, the government typically assumes a facilitatory role.

The fundamental difference between PPP and PES lies in the principle of who should pay, the polluter/party responsible for harm or the beneficiary. PPP aims to prevent or minimise environmental damage or substitute for lost biodiversity values, by disincentivising those causing harm with fees or other financial costs. PES aims to preserve or enhance existing nature value by incentivising landowners with subsidies or other financial incentives paid by the beneficiaries, typically public entities representing society, as in the METSO case, or companies, as in the Costa Rican case. It is noteworthy that, especially when private landowners provide compensatory areas, PPP schemes can also contain elements of PES, specifically when proceeds from the PPP scheme are used to incentivise nature-positive activities from other landowners. Landowners are remunerated for environmental measures that are usually determined in advance. These can be passive measures, such as protecting an area, or active measures, requiring specific management action. This distinction influences how the payment is calculated. For protected areas, the payment is typically based on the foregone economic revenues, while in active management, the cost of measures (planning, implementation, etc.) is covered.

Almost all mechanisms have the potential to scale up, either to other ecosystems or regions. In particular, the examples demonstrate a range of approaches to implementing these mechanisms to accommodate various legislative, economic and natural environments. In the case of a price premium, the setting a premium could be mimicked in other industries, but the premium needs to be adjusted to each industries' products and suppliers.

Table 1. Key features of the mechanisms in the presented cases

	Polluter pays principle (PPP)	Payments for ecosystem services (PES)	Voluntary solutions in the private sector
Objective	Aims at behaviour change first and then levies fees. A fee-based mechanism.	Aims at behaviour change through the redirection of funds. A subsidy-based mechanism.	Aims at behaviour change through the redirection of funds. Generally, a subsidy-based mechanism.
Payer	The party causing the environmental harm or risk.	Beneficiary of nature value, typically a public agent or a company.	Private company, investor or consumer.
Role of government	Major	Major	Minor
Generation of funds for environmental activities	Payments for mitigatory actions or credits.	Public budgetary funding, private funding.	Price premium or investment.
Basis for payment	Based on the price of biodiversity credits, damage caused or the cost of mitigation measures.	Based on cost of lost economic opportunities.	Based on market prices of commodities (price premium) or estimated return on investment.
Potential for scaling	Large national/other ecosystems.	Large national, sometimes international/other ecosystems.	Medium national or international/other ecosystems in some cases.

3.2. Assessment of examples applying the polluter pays principle (PPP)

Examples that use a PPP instrument:

1. Biodiversity Net Gain (BNG), UK, Europe
2. German Impact Mitigation Regulation, Europe
3. Wetlands Compensatory Mitigation Rule in USA, North America

This study included three PPP cases, two from Europe and one from North America. The European cases cover multiple ecosystem types, and the USA case study concentrates on wetlands. All three examples are based on implementing a mitigation hierarchy, starting from avoiding negative impacts and, as a last resort, offsetting residual impact. All three cases also employ a PPP mechanism that directs the collected fee to a third party to fund nature-positive activity. The aim of this type of PPP mechanism is to increase the costs of harmful economic activity and incentivise nature-positive measures.

The UK BNG case emphasises the concept of achieving additional net gain. Additionality, which means that biodiversity benefits are based on actual environmental improvements and verified against an appropriate baseline, is one of the key principles for ensuring integrity.

Governments play a leading role in all PPP cases studied by setting legislative measures to make mitigation mandatory. In addition, governments provide standards, procedures and secure contractual certainty. Governments often play an important role in establishing habitat banks to secure compliance and volume of compensatory areas. The compensation for mitigatory action is derived from those within the economy that cause damage to the environment, such as property developers. PPP instruments can increase efficacy when compensatory fees are actively used to improve the state of nature. As demonstrated in the case studies, this can be achieved through integrating PES and habitat banking into the compensation scheme.

Another key enabler is the presence of intermediaries and so the creation of other business opportunities in nature markets. In the case studies, the intermediaries involved included environmental consultants and non-governmental organisations (NGOs). Brokers and the establishment of habitat banks are also needed in cases of compensation, where compensatory areas, offered by habitat banks, are needed to offset harm in another location. Apart from providing land to habitat banks, private or public landowners may rent land for compensatory areas and sell biodiversity credits on other regulated platforms. Thus, PPP schemes can stimulate a market between suppliers of nature-positive measures and purchasers needing to offset their harmful activities. The schemes provide market opportunities to different consultancies in the various phases of the mechanisms.

In addition to mandating participation, mandatory PPP instruments establish the criteria for relevant assessment, evaluation and monitoring of the scheme. To ensure success, these processes should be easy to access, simple to use and transparent. Attention is given to validation and verification processes by third parties and capacity building for intermediaries to describe the required skills and knowledge base.

When compensation is used as a mitigation measure, the availability, a clear framework for the compensation procedure and clear definitions of equivalency between habitat types and locations of compensatory areas become crucial. While landowners or habitat banks offer the land and sell biodiversity credits to developers in need, issues may arise when a suitable supply of similar habitats is insufficient to meet developer demand. It was demonstrated in the early implementation of the Wetlands Compensatory Mitigation Rule in USA with too strict rules on compensatory areas. This may result in sub-optimal solutions, involving areas with lower or different biodiversity value than those found at the original site.

Compensating for harmful biodiversity impacts is inherently challenging in terms of quantification, monitoring and verification. Unlike carbon markets, which can rely on a standardised unit (CO_2 equivalent), biodiversity equivalencies are still in development, with no widely adopted standard. A common approach involves identifying comparable habitats in the vicinity. In the UK Biodiversity Net Gain case, a biodiversity metric based on the extent and condition of the habitat was introduced as a proxy for a standardised unit. The price to mitigate actions via a third-party credit often depends on the costs associated with the third party establishing the necessary compensatory area. Case studies indicate significant challenges in monitoring and ensuring long-term ecological benefits.

Both carbon and biodiversity compensation face common challenges: additionality and permanence. Additionality refers to verifying that a positive impact associated with an offset is truly improving the baseline situation. For example, if the land use of the compensatory area would have remained unchanged even without the compensatory scheme, there is no gain, let alone a net gain, in using it for compensation.

Regarding permanence, it is imperative to sustain biodiversity benefits for an extended period after completing habitat enhancement works, otherwise there is no compensation in the longer term.

Regulation of biodiversity-related PPP is still in the early stages of development in many countries. As the framework for the PPP is usually based on national laws, scaling-up possibilities are typically limited to the national level. In larger countries, the implementation may vary between regional entities. Many of the cases could also be adopted in other ecosystems, but this would usually need additional legislation. To encourage the successful implementation of PPP instruments, it is essential for the success to concurrently consider socio-economic impacts alongside ecological concerns.

Finland does not have mandatory PPP legislation related to biodiversity or land use. The Environmental Conservation Act (Luonnonsuojelulaki 2023) includes voluntary ecological compensation, which is discussed in section 3.4 on voluntary mechanisms. The case studies in this report highlight that both mandatory and voluntary economic instruments can play a role in preventing or remedying damage to nature, or indeed achieve an enhancement or net gain for nature. It is beyond the scope of this report to make a firm judgement on whether mandatory PPP legislation related to biodiversity and land use would be needed to meet Finland's international, EU and national biodiversity goals. Voluntary ecological compensation has recently been enacted into law in Finland and the associated practical arrangements are being put in place. There is no experience yet as to whether compensation markets will emerge and how effective they will be. Regarding the next steps, it would be logical to use the experience from the voluntary compensation scheme when assessing the added value of mandatory ecological compensation.

3.3. Assessment of cases applying payments for ecosystem services (PES)

Cases that use a PES mechanism:

1. Forest Biodiversity Programme for Southern Finland, Europe
2. Burren Programme: hybrid agri-environmental scheme, Ireland, Europe
3. Payment for environmental services in Costa Rica, Central America
4. Piloting reverse auctions for biodiversity protection in Denmark, Europe
5. Agriculture Biodiversity Stewardship – Carbon + Biodiversity Pilot, Australia, Oceania
6. New York City Watershed Programme, USA, North America

Six cases represent different applications of the PES mechanism, three in Europe, one in North America, one in Central America and one in Oceania. The PES cases mainly cover forest ecosystems, but also agricultural land use. Two PES examples (the Costa Rica and New York cases) were established almost 30 years ago. Four were strongly led by national governments, one by a local government and one pilot case by a research organisation. In the PES cases studied, funding usually comes from public sources, national or local governments. However, in Costa Rica the funding comes from multiple sources, including the private sector.

When payments for ecosystem services (PES) receive funding from public sources, they are typically designed to support national or local policies addressing biodiversity loss. This alignment of policy goals often enhances public awareness and acceptance of using public funds for PES initiatives. Especially when applied on the national scale, successful PES implementation requires co-ordination and engagement of multiple stakeholders, presenting both a key to success and a potential risk if not executed

properly. Moreover, as PES instruments are generally funded publicly, they can be limited by the availability of public finances and annual budgetary decisions.

Payments within PES mechanisms are typically determined based on lost economic opportunities, the cost of conservation or management, or a broader range of measures carried out by landowners. In some cases, payments are based on the existence of elements of biodiversity, or other ecosystem services. For example, in Costa Rica an extra payment is given for forest protection if the forest area is particularly important for water provision services. It is uncommon for payments to be directly based on the intrinsic value of biodiversity; rather, they are often linked to the presence of specific biodiversity elements such as habitat types or ecosystem services. Hybrid solutions that combine compensation for costs or lost income with conservation outcomes also exist, demonstrated by the Burren case.

As PES cases depend on setting appropriate incentives, pilot phases can be useful for establishing incentives that achieve the goal of the programme. Two cases included in this study describe such pilot phases: piloting reverse auctions for biodiversity protection in Denmark and piloting the biodiversity enhancement market in Australia. Also, the Finnish METSO programme was preceded by a pilot phase, the experiences of which were used to design the programme.

Certain PES instruments use an auction mechanism aimed at improving cost-effectiveness through enhanced competition. For example, the Danish case study mentioned above describes the use of reverse auctions. However, incorporating auctions increases the skills and knowledge necessary for intermediary agents. The Danish case study shows that engaging landowners in planning the auction and bids was beneficial, but it would have required more planning to set clear guidelines and selection criteria.

Payments for ecosystem services (PES) also rely on the voluntary participation of landowners. Campaigns and advisory services are essential to enhance awareness and acceptance of the scheme. The level of commitment demonstrated by landowners varies across cases. In some instances, landowners may be required to co-finance investments, while in others, they may need to commit to extended management contracts. Certain cases, like the METSO programme in Finland, used different length of land-management contracts to address the varying landowner preferences and principles. This diversity must be considered when designing payment mechanisms. For example, some landowners may be hesitant to sell their land but willing to enter fixed-term contracts. Additionally, variations in personal principles mean that certain landowners might accept lower prices in auctions due to lower opportunity costs or a higher personal alignment with environmental benefits.

Another behavioural factor, trust, plays a pivotal role in the success of cases, particularly when landowners are tasked with maintaining environmental benefits for extended periods, ranging from 25 to even 100 years. Establishing and maintaining trust involves building long-term relationships with landowners. It also entails ensuring accountability, transparency, a participatory approach and openness in public policies and outcomes, while avoiding perceived or actual conflicts of interest.

The payments for ecosystem services (PES) cases examined in this study were limited to public funding and blended funding as in the Costa Rican case. However, instances of private funding in PES exist, involving non-governmental and non-profit organisations like the Finnish Natural Heritage Foundation.

Various applications of PES hold significant potential for scaling up to new areas, ecosystems and sectors. As a reward-based

instrument, cases using PES have had success fostering positive attitudes to biodiversity-positive activity on privately owned land. All of the examined cases highlight the importance of helping landowners consider how their actions influence local biodiversity and including this within their decision-making. However, the success lies in the details, and careful consideration must be given to designing and implementing PES in a credible and transparent manner. Achieving credibility and transparency requires reaching landowners and gaining their trust, acquiring precise knowledge of the biodiversity in need of protection and the necessary and appropriate conservation measures, determining payment structures suitable for the national culture, law and available resources, as well as establishing an efficient contract procedure. Many of the mature cases, and all the novel ones, involve a pilot phase to develop the design and implementation of PES policy.

Payments for ecosystem services (PES) are already being implemented in Finland. The METSO case featured in this study is one example. Nevertheless, there is potential for improvement and also for the establishment of new PES schemes. Integrating an auction element could help to provide more cost-efficient payments but would require landowners to accept a more laborious procedure of bidding for payments. Additionally, better incorporating a results-based component to complement payments based on lost income or activity costs would be a feasible and ecologically beneficial addition to the existing framework of the METSO programme.

3.4. Assessment of cases applying voluntary mechanisms

Voluntary mechanism cases:

1. Valio's sustainability programme, Finland, Europe
2. Fair to Nature certification system, UK, Europe
3. Rudus biodiversity programme, Finland, Europe
4. The World Bank Wildlife Conservation Bond, South Africa, Africa

Four examples of different voluntary mechanisms in the private sector – including companies and non-profit organisations – were included in the study, three from Europe and one from Africa. The cases cover multiple ecosystems, from forests to wetlands and agricultural ecosystems. Private organisations are voluntarily adopting mechanisms such as results-based investments, the polluter pays principle, certification systems, price premiums or voluntary compensation.

Even though the cases represent voluntary action in the private sector, governments often play roles varying from co-funders to facilitators. For example, the Global Environment Facility (GEF) funds the potential performance payment in the World Bank Wildlife Conservation Bond case, with GEF funds sourced from governments. Also, Rudus engaged with local governments to discuss the most appropriate locations for their compensatory actions. In this example, the local government plays a facilitatory role.

Intermediaries also usually play an important role in the voluntary mechanisms. For example, the Wildlife Conservation Bond uses conservation experts to verify the rhino population growth, which is a key element in the economic instrument. On the other hand, in the Valio case, one of the risks identified is the lack of transparent third-party verification.

Engaging in effective voluntary mechanisms requires businesses to understand their impact on biodiversity, the mitigation pathways available and the level of commitment from company leadership. As demonstrated by the Rudus case, companies may seek advice from conservation experts or projects working on conservation. They may in some cases also hire consultants to practically design and implement the voluntary scheme. Engaging experts helps ensure that the scheme addresses the targeted drivers of biodiversity loss and can add validity to subsequent communications.

Public awareness is a key factor when a price premium depends on market dynamics and customers choosing more nature-friendly products. In cases where a company voluntarily participates in a PPP scheme, public opinion is not critical. Compared to mandatory PPP cases, where the government sets the targets and largely selects the implementation procedure, the procedure in voluntary cases is instead decided by a private party. This arrangement might not promote alignment with national biodiversity policies.

Voluntary mechanisms are employed to finance either biodiversity conservation or both biodiversity and carbon actions, thereby mitigating the biodiversity and carbon footprints of private companies. In optimal scenarios, these mechanisms align with global and national biodiversity strategies and support the implementation of national biodiversity strategies and action plans (NBSAPs).

In principle, private voluntary cases could be scaled up to different regions and ecosystems. In practice, this is often constrained by companies' focus on their specific sector of trade and markets. Costs associated with these voluntary cases may also be a barrier, as companies experimenting with such schemes are introducing new cost items compared to their competitors. Nevertheless, these cases could serve as benchmarks for other companies looking to design voluntary initiatives. Industry associations could help in developing private voluntary mechanisms for their specific industries and sectors.

Some Finnish companies, like Rudus, have been among the pioneers in voluntarily adhering to the polluter pays principle to mitigate environmental harm. In Finland, the Environmental Conservation Act of 2023 includes voluntary ecological compensation (Luonnonsuojelulaki 2023). The law stipulates that a party causing degradation in natural values through its activities can compensate for the impairment to a habitat or the living environment of a species with compensatory measures or with conservation compensation. The compensatory measures include restoration action, an increase of area in the living environment for habitats or species, or improvement of the ecological quality of the environment of a habitat or a species. The conservation compensation entails permanent protection of a representative endangered habitat. The law also specifies the criteria for compensatory areas, details of the compensatory plan and which costs are to be covered. The entity causing degradation can apply to a regional state agency for a decision on compensation. Thus, the governmental role, partly implemented through intermediary agencies, is to facilitate the creation of a compensatory market and oversee and verify the transactions.

Outcome-based loans and other types of impact investment have the potential in Finland to attract not only national but also international funds, given the country's relatively sound social, political and environmental state. It is worth investigating whether outcome-based loans could be applied to protect unique features in Finland like the Saimaa ringed seal or Finnish bogs.

3.5. Assessment of cases applying other mechanisms

Other mechanism cases:

1. Quintana Roo coral reef insurance, Mexico, North America
2. Insurance services and mangrove protection pilot scheme in the Philippines, Asia
3. Compensation for the construction of an Espoo data centre, Finland, Europe
4. Hamburg Green Roof Strategy, Germany, Europe

Four cases fall into the other mechanisms category, two representing insurance-based innovations and two local government cases. In the insurance-based cases, intermediaries play a crucial role by providing ecological expertise to the mechanisms, while in the local government cases, the municipalities provide in-house ecological expertise. Given the significant differences among these cases, a collective assessment is not feasible, however some of the general lessons learned are outlined below.

The restoration insurance case based in South-East Asia and the Mesoamerican parametric insurance case represent mechanisms in which the preservation of a functioning habitat mitigates risks to property damage, and the costs of risk reduction are shared among various stakeholders. The insurance services and mangrove protection pilot scheme in the Philippines example represents a model in which mangrove protection and restoration is funded by insurance-related revenue, which is generated through property damage risk reduction with funds sourced from policy holders and the sale of carbon credits generated from restoration measures. The challenge related to insurance is that it is supported by premiums that must be sustainable over the long term for both public and private-sector policy holders. It is thus important to secure a long-term commitment from policy holders to the insurance. A possible solution might be offered by risk sharing through the involvement of a public body and/or reinsurance. There is also a basis risk associated with the payout of parametric insurance as the monetary value is based on the severity of a climate event, not the damage incurred.

In insurance cases, scaling up to other ecosystems is feasible and may require the design of new insurance products. However, scaling may be constrained by national legislation. In the Quintana Roo parametric insurance case, Mexican national legislation allows a certain flexibility in insurance policy design, while in the EU countries, the insurance sector is more strictly regulated.

The other two voluntary mechanisms were established by European local governments to implement their strategic commitment to prevent the loss of nature and to mitigate their ecological and carbon footprint related to forest and urban ecosystems. A distinctive aspect of these two cases is the absence of intermediaries, which is covered by in-house ecological expertise. Public awareness is important to the acceptability of using municipal funds in these cases. Local governments risk a lack of transparency when operating independently and failing to effectively communicate the costs and benefits associated with the scheme.

Examples of functioning instruments, such as the examined cases, could be easily scaled to other local governments that experience the same drivers of biodiversity loss. Financial instruments have the potential to complement public finance in achieving biodiversity targets while simultaneously promoting local livelihoods and sustainable development. For example, a price premium could be developed for the insurance of building communities that have sufficient green area, such as green roofs, helping to reduce flooding risk. Insurance solutions for housing, agriculture, forestry and wildfires are being developed in the PIISA Horizon project. Finland is one of the countries where the applications will be tested in various pilot schemes (PIISA 2023).

3.6. Co-benefits and co-operation are essential for successful implementation

In addition to targeted biodiversity benefits, the reviewed mechanisms all generate ecological co-benefits, either incidentally or intentionally integrated into the mechanism. These co-benefits can contribute to climate change mitigation and adaptation, as well as local air and water protection. In addition to extra environmental gains, these mechanisms also often yield co-benefits that contribute to human well-being. These benefits can encompass employment opportunities, economic prospects, recreational spaces and the safeguarding of cultural and landscape values. The creation of co-benefits emerges as a crucial success factor in the pursuit to safeguard or enhance biodiversity and ecosystem services.

The effectiveness of economic mechanisms relies on the action of landowners, particularly forest owners or farmers. Engaging landowners in a collaborative manner is vital, and successful collaborations often make use of tailored advisory services to ensure the desired land-management results. Furthermore, local acceptance is paramount for any biodiversity-focused initiative. It diminishes the possibility of illegal activities such as logging and poaching. Successful cases underscore the importance of providing benefits to local communities, such as job opportunities, community development or recreational amenities. If nature, for instance, becomes a tourist attraction generating income, there is a higher likelihood of its sustainable use and protection. The importance of these types of co-benefits is more visible in developing countries, but also important in countries like Finland.

Cases that rely on public funds are often subject to annual budgetary decisions. Hence, public acceptance of funding the activities is crucial. Effective communication about the benefits and challenges associated with the mechanism is vital for its long-term viability.

Collaboration with scientists emerges as another pivotal success factor, facilitating the assessment of ecological impacts. In numerous successful cases, scientists have been involved in the planning or pilot phases, or they have actively participated in designing and implementing monitoring procedures for conservation or biodiversity management success.

A common denominator for the cases selected for this study, all deemed successful, is the management of economic instruments by trusted and credible organisations; either one involved in the project or a third party. Their consolidated expertise and the trust they garner from the target group, stakeholders and the general public constitute key factors in the success of these initiatives.

4. Conclusions

4.1. Securing nature's wealth needs incentives for behavioural change

As we recognise the implications of biodiversity loss, it has become clear that companies and organisations need to integrate nature into their decision-making. The challenge is that biodiversity and many ecosystem services lack market value, resulting in undervaluation and, hence, underfunding and undersupply. By putting the right incentives in place, such as putting a price on causing harm and rewarding positive behaviour, these cases demonstrate efficient methods for reducing biodiversity loss.

New economic instruments and mechanisms have emerged to address this pressing issue. Payments for ecosystem services have already been adopted across various regions and mechanisms rooted in the polluter pays principle are undergoing increased development. Concurrently, new voluntary market-based instruments are emerging within the financial sector and pricing systems for goods and services. The UK Net Gain case demonstrates the potential of including the concept of net gain in PPP schemes, with the aim of going beyond damage compensation and increasing natural value over time.

Economic instruments have the potential to change the behaviour of companies and consumers, in addition to directing money to maintain biodiversity and ecosystem services. Well-designed economic instruments offer incentives for adopting measures that help in securing natural value or avoiding measures that harm nature.

In conclusion, the findings of this study underscore the critical importance of economic instruments in halting biodiversity loss. This report sought to analyse a wide range of cases, to reveal the success and viability of economic instruments designed to enhance the value of nature. These mechanisms can be used to incentivise companies and landowners to mitigate their harmful practices and promote positive activities, such as protection and enhancement of natural habitats.

This study emphasises the potential of economic mechanisms to discourage activities harmful to biodiversity and promote biodiversity-positive action to reverse the alarming trends in biodiversity decline. Instead of exclusively depending on regulatory measures or public funding, the involvement of the private sector through financial incentives demonstrates significant efficacy. Such instruments seek to promote synergies between public and private interests, balancing the interests and incentives of various groups of stakeholders. This study highlights that there is an abundance of international examples of very diverse and innovative mechanisms. These can serve as sources of inspiration for governments and companies seeking economic models to recognise the value of nature within decision-making and establish relevant financial incentives to enhance biodiversity and avoid its loss.

4.2. Involvement of the private sector in financing biodiversity conservation is paramount

There currently exists an excellent opportunity to draw the private sector into financing the protection and enhancement of biodiversity and ecosystem services. The European Union is undertaking a transformative shift in the operating environment for the private

sector in terms of biodiversity and environmental sustainability. Initiatives such as the Common Agricultural Policy (CAP) reform and Nature Restoration Law are pushing companies and landowners to align their operations with broader ecological objectives. This not only changes the operating environment but also encourages businesses to contribute actively to ecosystem restoration efforts. The EU Taxonomy and the Corporate Sustainability Reporting Directive (CSRD) urge businesses to transparently communicate their impact on biodiversity. These initiatives collectively reshape the regulatory landscape, fostering an environment where corporate responsibility is integral to business practices.

As demonstrated in the voluntary mechanism cases in this study, some businesses are increasingly taking voluntary action to conserve biodiversity and related ecosystem services. Many businesses are recognising that active engagement in biodiversity conservation is not just a moral obligation but a strategic business move. The change is partially driven by demands from consumers and investors, making biodiversity as part of a broader sustainability objective an important competitive factor in the market. Recent changes in the regulatory environment, as mentioned above, also play a role.

The study emphasises that governments play a pivotal role in harnessing this momentum and facilitating increased private-sector involvement. Some of the cases presented in this study involved mandatory measures following the polluter pays principle, obliging those in the private sector to consider biodiversity in their decision-making. In the literature review of various databases, there were few examples of mandatory PPP-based instruments specifically targeting biodiversity. By playing an enabling role alongside that of a regulator, governments can create conducive environments for businesses to contribute effectively. This involves establishing clear standards and frameworks that guide businesses to align their operations with national biodiversity strategies and action plans (NBSAPs). Providing incentives, both regulatory and financial, can further motivate private enterprises to invest in addressing biodiversity loss.

The increasing global attention on environmental stewardship calls for innovative collaborations between governments, scientists and the private sector. Creating platforms for dialogue and co-operation, fostering partnerships and establishing transparent regulatory frameworks can encourage businesses to proactively engage in biodiversity protection.

4.3. Effective and fair design, implementation and monitoring are often a result of a learning process

Based on the cases assessed, several key features can be noted in all mechanisms. Mechanisms take time to mature and involve learning processes for all stakeholders. In order to develop, regular third-party evaluations of mechanisms are needed. However, it is most important for policymakers to take the first step, implement appropriate mechanisms while leaving room for learning how these mechanisms may be improved, for example by using pilot studies. The successful mechanisms highlight simplicity, transparency and alignment with the priorities set for biodiversity, climate and water policy at sub-national level. New policy initiatives, at their best, can create opportunities for new economic mechanisms and new job opportunities for intermediaries. The role of intermediaries should be standardised and provided with clear requirements to ensure high-quality implementation of the mechanism.

To ensure an ecological impact, monitoring schemes, regular assessments and audits are essential, as well as the engagement of ecological expertise, either in-house or as a

third-party service. In many cases, non-governmental nature-related organisations played a critical role, supplying necessary ecological and local expertise. Biodiversity and ecosystem services, as well as their ongoing maintenance, are complex and long-term processes that benefit from platforms that aim to bring together policymakers, the scientific community and businesses to discuss and align interests in favour of the environment and society.

4.4. Promotion of biodiversity goes hand in hand with socio-economic and other ecological benefits

In conclusion, the cases examined in this study underscore the various economic instruments available to help address biodiversity loss. To maximise the outcomes of these instruments, it is imperative to adopt a comprehensive approach that simultaneously addresses multiple ecosystem services, including carbon sequestration and water quality. Integrating multiple environmental objectives into biodiversity-enhancing schemes not only optimises the allocation of scarce resources but also promotes holistic ecosystem management. By recognising the interconnectedness of various environmental components, these schemes can deliver more extensive and lasting benefits.

The collaborative engagement of various stakeholders is pivotal in effective conservation efforts. The integration of social, cultural and economic considerations into biodiversity initiatives is a necessity and a key driver of long-lasting, equitable outcomes. It is evident from the case studies that the success of biodiversity conservation initiatives relies not only on the preservation of natural habitats but also on fostering positive socio-economic impacts. In addition to protecting species and ecosystems, activities addressing biodiversity loss should also actively contribute to local economies, cultural preservation and social cohesion. By recognising the intricate interplay between ecological health and societal well-being, we can pave the way for more comprehensive and enduring solutions. The cases demonstrate that we have the opportunity to design multifunctional economic instruments, where biodiversity, climate and social objectives can and should be set simultaneously.

4.5. Key takeaways

Listed below are some important points that need to be borne in mind for the successful implementation of economic mechanisms for safeguarding and financing biodiversity and ecosystem services.

1. There are numerous good examples of using economic instruments to safeguard biodiversity and ecosystems. Expanding the use of these instruments is crucial to reversing biodiversity decline.
2. Economic instruments can be used to strengthen private-sector alignment with national and international biodiversity priorities.
3. Financial incentives, training and collaboration should be used to empower landowners for biodiversity conservation.
4. Governments are pivotal to encouraging private-sector involvement, transforming from being only regulators to also be enablers by providing clear standards and incentives that allow measures to be scaled up.
5. Platforms for dialogue and collaboration, bringing together governments, scientists and businesses, are essential for ensuring the commitment of companies and the ecological effectiveness of the action.
6. Ensure uniform capacity building for all stakeholders, especially intermediaries, in the early stages.
7. Besides biodiversity itself, it is critical to also recognise climate, water and

soil-related co-benefits. Designing economic instruments in a manner that generates co-benefits and simultaneously addresses multiple environmental challenges is often efficient and necessary.

8. When local communities experience benefits from the preservation of biodiversity and ecosystem services, their motivation to actively participate in conservation efforts increases.
9. In Finland, several mechanisms presented in case studies, like payments for ecosystem services and voluntary compensation, are already in use. To reach the goals in biodiversity and ecosystem service policies, new economic instruments could be developed after a thorough evaluation of their legal, ecological, economic and political implications and feasibility.

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