# Sustainable agriculture and Nature-based Solutions

Tommaso Demozzi, Barbara Pia Oberč, Ana Prieto López, Ludovic Larbodière, Maria Ana Borges

Alberto Arroyo Schnell, editor

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The *IUCN Common Ground on Food and Agricultural Systems* series documents the importance of sustainable agriculture and food systems, feed the dialogue between agriculture and conservation actors, and help them balance human well-being, natural resources and life on Earth.

This report focuses on Nature-based Solutions (NbS) in the agricultural context. The aim is to provide experts and policymakers with ideas, recommendations and concrete uses for NbS, ultimately helping to outline a potential path for a more sustainable and just future.

The *Common Ground on Food and Agricultural Systems* series ambitions to explore the complex relationships between nature, agriculture and agri-food systems to inform policies and better address food security, climate change and nature conservation challenges.

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# Foreword

**Virginijus Sinkevičius**
Member of the European Parliament and former EU Commissioner for Environment, Oceans and Fisheries (2019–2024)

Biodiversity and climate are deeply intertwined. For biodiversity to thrive, we need a stable climate – and to keep the climate stable, one important element is keeping global biodiversity in a healthy state. This fundamental realisation should run through all our thinking about nature and climate, and underpin our determination to act strongly for climate and nature.

Our food system depends on biodiversity, clean water and air, and healthy soils. It cannot withstand an unstable climate. This means that long-term food security is profoundly dependant on the health of our environment, and that our social and economic goals will not be achieved if we continue to allow nature to decline.

The EU is strongly committed to a fair transition to sustainable food systems, and to a future that reconciles its food security, climate, biodiversity and socio-economic objectives. That transformation will depend on joint solutions across sectors. The European Green Deal is a growth strategy for that process of change, delivering a sustainable future, where agricultural production and nature go hand in hand.

Nature-Based Solutions can bring a triple win to people – starting with farmers – to our planet and to our economy. And with the adoption of the IUCN's Global Standard for Nature-based Solutions for the agricultural sector, the world now has an important instrument to drive the concept forward and enable much wider uptake on the ground.

The report that follows helps highlight the immense potential of Nature-Based Solutions. By combining a rigorous theoretical analysis with real-world case studies, it offers concrete recommendations to policymakers, and points farmers towards solutions that tackle environmental challenges and that can be realistically implemented on the ground.

Solutions that bring us closer to the future we want: a stable climate, healthy biodiversity and a food system firmly anchored in sustainability.

# Executive summary

Unsustainable agricultural practices are among the main causes of biodiversity loss, climate change, and pollution globally. It is thus essential to integrate environmental conservation practices in the agriculture sector when looking at pathways for a sustainable future. In this context, Nature-based Solutions (NbS) could be a critical tool for improving the status of productive landscapes. Their potential to provide a "triple-win" for people, planet, and economy makes them a valuable pathway for farmers, businesses, and conservationists. NbS is now a widely used concept in many sectors and among decision-making bodies, however it needs a clear and robust base, using the best available information.

This publication focuses on the relationship between sustainable agricultural practices and the concept of Nature-based Solutions, and specifically the applicability of the IUCN Global Standard for NbS™ (IUCN, 2020a) in agricultural contexts. The aim is to provide experts and policymakers with ideas, recommendations, and concrete uses for these tools, in order to outline a potential path to a more sustainable future for the agricultural sector.

For this report, an analysis of the alignment of different approaches to sustainable agriculture (Oberč & Arroyo Schnell, 2020) with the criteria of the IUCN Global Standard for NbS™ was carried out. It is important to underline that NbS characterises an intervention in its different dimensions. Therefore, a specific sustainable agriculture practice or approach cannot be considered as a Nature-based Solution as such, as it will depend on the way it is implemented. We can only affirm whether it aligns or not align with the criteria of the IUCN Global NbS Standard™. It is also important to note that in most cases the approaches considered, even if they do not align perfectly with criteria of the NbS standard, would be a better alternative to many modern conventional farming practices.

A first conclusion of the report relates to the level of importance that environmental targets –particularly those pertaining to biodiversity conservation– should have in relation to the concept of NbS in the agricultural sector. When implementing NbS, it is critical to ensure the adequate fulfilment of the biodiversity net gains and ecosystem integrity requirements. The analysis shows that a group of sustainable agriculture approaches analysed (agroecology, nature-inclusive agriculture, regenerative agriculture, biodynamic agriculture, and organic farming) place biodiversity at the core of their theoretical basis. The focus is not only on preserving, but also enhancing biodiversity. These approaches look at the broader landscape, take economic dimensions into consideration, and can be applied relatively easily at scale. They show strong alignment with the criteria of the IUCN Global Standard for NbS™, and with the concept of Nature-based Solutions when implemented correctly on the ground.

In any case, to better align the approaches with the criteria of the IUCN NbS Global Standard for NbS™, and to promote in general the uptake of NbS in agriculture, several measures should be considered for each sustainable agriculture option.

For instance, to enhance biodiversity net gain and ecosystem integrity farmers can implement some transversal practices that have been identified as sustainable in the relevant literature, such as crop rotation, the

inclusion of cover and companion crops, mixed crop and intercropping, reduction of synthetic pesticide and mineral fertiliser use, no or minimal tillage, lower livestock densities, managed grazing, free range, crop diversification, mixing farming and forestry, mixed crop and animal farming, nutrient balancing, recovery and reuse, the inclusion of landscape elements such as hedgerows and flower strips, and agroforestry or ecosystem restoration.

Moreover, to support their economic viability, public and private investors can prioritise the deployment of NbS over conventional farming solutions. Financial instruments that cater to the longer NbS timeframe should be made available, making it easier to transition investors' mindsets from short-term temporary fixes to long-term solutions. In this context, and as part of this measure, harmful agricultural subsidies should be redirected to benefit NbS and smallholder farmers. This might be done through granted public support and easier access to grant mechanisms as well as loans to cover any additional investment needs in the application of NbS. Indeed, a set of nature positive incentives, redirected from the current unsustainable subsidies' schemes, could boost the market competitiveness of an NbS intervention.

In addition, there are multiple case studies that can serve as governance best practices to farmers and other stakeholders. These include the multi-stakeholder dialogue processes, the respect for the principle of Free Prior and Informed Consent (FPIC), the coordinated decision-making process, and others. These are diverse scenarios that can help farmers to determine which governance model(s) might suit them best.

Policy will play a fundamental role in the promotion of Nature-based Solutions in agriculture. In this context, it would be useful to consider a specific stream of work on agriculture and Nature-based Solutions under the three Rio Conventions. Furthermore, to fully implement the Kunming-Montreal Global Biodiversity Framework (KMGBF), and in particular the targets where NbS are explicitly mentioned (Targets 8 and 11), the integration of the IUCN Global Standard for NbS™ would strengthen the scientific basis of the targets through the monitoring, reporting, and reviewing mechanisms of the KMGBF itself.

In the European Union, which aims to be a leader in environmental issues especially after the launch of the European Green Deal in 2019, and where the Common Agricultural Policy plays a key role in the agricultural governance of its 27 Member States, a strengthening of policy coherence in the different components of its European Green Deal and beyond would be very beneficial for the integration of Nature-based Solutions. With regard to the future EU Common Agricultural Policy, a stronger integration of NbS in the next Multiannual Financing Framework beyond 2027 would be needed. The IUCN Global Standard for NbS™ can be useful here, as a key tool in ensuring that the necessary safeguards for the implementation of NbS are respected.

Finally, it is important to emphasise that this report responds to the request of IUCN Members, as expressed in IUCN Resolution 7.007, calling on the Secretariat of IUCN to seek relevant funds and prepare a report on agroecological practices as Nature-based Solutions. Following this Resolution, IUCN recommends to its Members and key international organisations active in this field (FAO, IPBES, IPCC, the High-Level Panel of Experts on Food Security and Nutrition (HLPE), the International Partnership for the Satoyama Initiative (IPSI), and others to use this publication as a key source for future discussion on Nature-based Solutions in agriculture.

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# Acronyms

| | |
|---|---|
| **AFOLU** | Agriculture, Forestry, and Other Land Use |
| **CBD** | Convention on Biological Diversity |
| **CCFC** | Community Cloud Forest Conservation |
| **CCHA** | Community Controlled Hunting Areas |
| **CCICED** | China Council for International Cooperation on Environment and Development |
| **COP** | Conference of the Parties |
| **CPI** | Climate Policy Initiative |
| **CSA** | Climate-smart agriculture |
| **DG AGRI** | Directorate-General for Agriculture and Rural Development (European Commission) |
| **DG CLIMA** | Directorate-General for Climate Action (European Commission) |
| **DG RTD** | Directorate-General for Research and Innovation (European Commission) |
| **EAT-Lancet** | EAT-Lancet Commission on healthy diets from sustainable food system |
| **EC** | European Commission |
| **EEA** | European Environment Agency |
| **EFNCP** | European Forum on Nature Conservation and Pastoralism |
| **EIP-AGRI** | Agricultural European Innovation Partnership (European Commission) |
| **EMF** | Ellen MacArthur Foundation |
| **ENACT** | Enhancing Nature-based Solutions for an Accelerated Climate Transformation |
| **ERA-NET** | European Research Area Networks |
| **EU** | European Union |
| **FAO** | Food and Agriculture Organization of the United Nations |
| **FOLU** | Food and Land Use Coalition |
| **FPIC** | Free Prior and Informed Consent |
| **GEF** | Global Environment Facility |
| **GHG** | Greenhouse gas |
| **GPD** | Gross Domestic Product |
| **HNV** | High Nature Value |
| **HPLE** | High-Level Panel of Experts on Food Security and Nutrition |
| **ICIMOD** | International Centre for Integrated Mountain Development |
| **IDDRI** | Institute for Sustainable Development and International Relations |
| **IFAD** | International Fund for Agricultural Development |
| **IFOAM** | International Federation of Organic Agriculture Movements |
| **IIED** | International Institute for Environment and Development |
| **IISD** | International Institute for Sustainable Development |
| **ILO** | International Labour Organization |
| **IPBES** | Intergovernmental Platform on Biodiversity and Ecosystem Services |
| **IPBES-FOOD** | International Panel of Experts on Sustainable Food Systems |
| **IPCC** | Intergovernmental Panel on Climate Change |
| **IPSI** | International Partnership for the Satoyama Initiative |
| **ITPS** | Intergovernmental Technical Panel on Soils |

| | |
|---|---|
| **IUCN** | International Union for Conservation of Nature |
| **IUCN CEM** | IUCN Commission on Ecosystem Management |
| **IUCN WCC** | IUCN World Conservation Congress |
| **IUCN WCPA** | IUCN World Commission on Protected Areas |
| **KMGBF** | Kunming-Montreal Global Biodiversity Framework |
| **LEIA** | Low external input agriculture |
| **LPU** | Laboratorio di Permacultura Urbana |
| **MedINA** | Mediterranean Institute for Nature and Anthropos |
| **NbS** | Nature-based Solutions |
| **NBSI** | Nature-based Solutions Intiative |
| **NGO** | Non-governmental organisation |
| **NOLs** | Non-operating landowners |
| **NRGF** | Natural Resource Governance Framework |
| **OAP** | Organic Action Plan |
| **OECD** | Organisation for Economic Co-operation and Development |
| **PFM** | Participatory Forest Management |
| **ROAM** | Restoration Opportunities Assessment Methodology |
| **SCBD** | Secretariat of the Convention on Biological Diversity |
| **SDG** | Sustainable Development Goal |
| **SMART** | Specific, Measurable, Attainable, Realistic and Timely (targets) |
| **STAR** | Species Threat Abatement and Restoration |
| **TNC** | The Nature Conservancy |
| **TYFA** | Ten Years for Agroecology |
| **UN** | United Nations |
| **UN DESA** | United Nation's Department of Economic and Social Affairs |
| **UNCCD** | United Nations Convention to Combat Desertification |
| **UNDP** | United Nations Development Programme |
| **UNEA** | United Nations Environment Assembly |
| **UNEP** | United Nations Environment Programme |
| **UNEP WCMC** | UNEP World Conservation Monitoring Centre |
| **UNEP-IEMP** | UNEP International Ecosystem Management Partnership |
| **UNFCCC** | United Nations Framework Convention on Climate Change |
| **WCS** | Wildlife Conservation Society |
| **WUR** | Wageningen University & Research |
| **WWF** | World Wide Fund for Nature |

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# 1. Introduction

Agriculture is an essential human activity. It provides the food, feed, and fibre we need, it sustains our economies and shapes our landscapes, while supporting rural communities. It is a fundamental part of our cultural heritage. Our history is closely tied to agriculture, and many consider our relationship with the land to be spiritual (Verschuuren et al., 2021). In spite of this, the decoupling of agriculture from nature's regenerative cycles is now contributing to an increasing ecological imbalance which now threatens the health of our ecosystems, and ultimately our own wellbeing (EEA, 2023; IPES-FOOD, 2016). Scientific evidence indicates that unsustainable agriculture and land use changes are significant drivers of this unprecedented loss of biodiversity (Benton et al., 2021).

Agriculture relies on healthy, resilient, and well managed ecosystems. For example, almost 75% of the world's crops that produce fruits and seeds for human consumption depend, at least in part, on pollinators (FAO, 2018b). It is because of this reliance and impact on nature that food is considered by many to be the single strongest lever for the optimisation of human health and environmental sustainability (EAT-Lancet, 2019). A shift towards a more environmentally friendly food system through better agricultural practices is therefore necessary if we are to achieve the goal of *living in harmony with nature* (CBD, 2010).

Led by its science-based approach, IUCN has been working on mainstreaming biodiversity conservation in all sectors, including agriculture. In 2021, the Sustainable Agriculture and Land Health Initiative was launched in order to boost the implementation of IUCN's agricultural programme across its activities[1]. The Initiative built on decades of expertise and on key IUCN publications, including Common Ground (Larbodière et al., 2020) and Approaches to Sustainable Agriculture (Oberč & Arroyo Schnell, 2020). This report is a continuation of these efforts, as reflected also in recent IUCN resolutions (see box below). The report aims to provide insights to readers – including policymakers – on the interlinkages between sustainable agricultural practices and Nature-based Solutions (NbS).

IUCN defines Nature-based Solutions as "*actions to protect, sustainably manage, and restore natural or modified ecosystems, that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits*" (IUCN Members Assembly, 2016). Therefore, NbS are a key ally in the fight against biodiversity loss and climate change, as well as a valuable tool for sustainable development (IUCN, n.d.-a, Hallstein & Iseman, 2021). In an agricultural context, the UN Food and Agriculture Organization (FAO) stated that NbS are cost-effective interventions with the capacity to enhance resilience in agriculture and food production, while mitigating the effects of climate change and support ecosystem restoration (Iseman & Miralles-Wilhelm, 2021). Just as an example, in Europe, rewetting 3% of the EU's drained peatlands in agricultural areas could reduce agricultural GHG emissions by 25% (Birdlife International et al., 2022) and positively contribute to ecosystem restoration.

1 IUCN (2021b). Sustainable Agriculture and Land Health Initiative [Conservation Tool]. Initiation Note 28/04/2021

## Answering the Resolutions of the IUCN World Congress

At the World Conservation Congress in Marseille in 2021, IUCN Members adopted two Resolutions related to Nature-based Solutions: Resolution 7.007 on Developing agroecological practices as nature-based solutions (IUCN Members Assembly, 2020a) and Resolution 7.060 on Promotion of the IUCN Global Standard for Nature-based Solutions (IUCN Members Assembly, 2020b). These two resolutions form the basis of this report, in particular Resolution 7.007. In fact, the latter calls on the *IUCN Secretariat to seek relevant funds and prepare a report on agroecological practices as nature-based solutions (NbS)*. It is important to note that this Resolution focused solely on agroecological practices, while this study looks at the broader concept of sustainable agriculture. The authors believe that a more comprehensive approach, while maintaining a significant focus on agroecology, would better answer the Resolution by reflecting the need for diversity according to the different contexts. By doing so, the NbS concept is mainstreamed across sustainable agricultural discourse, thus promoting wider uptake while partly answering to the Congress resolutions.

It is important to stress that neither sustainable agriculture nor Nature-based Solutions can solve the ongoing environmental crisis in isolation. Effective and inclusive conservation measures, a drastic cut in emissions, and a shift towards nature-positive practices across all sectors are essential elements for a sustainable future. Policymakers should not search for a single silver bullet, which in some cases could exacerbate the polycrisis (Bateman & Balmford, 2023), rather they should seek to implement a plethora of cross-cutting and holistic measures. In the case of food systems, for example, the Food and Land Use Coalition identified ten critical transitions necessary to transform food and land use, including an enhanced conservation of natural ecosystems, healthier diets, and fostering local circular food economy models (Pharo et al., 2019).

The reasoning for the focus on Nature-based Solutions in this report is two-fold: on the one hand, NbS could be a critical ally in improving the status of productive landscapes. Their potential to offer a “triple-win” for people, planet and economy makes them a valuable pathway for farmers, businesses, and conservationists. On the other hand, they are now a wide-spread concept in many sectors and among decision-making bodies. As a result, a clear and robust conceptual base is needed, using the best available information. This report also aims to help in this regard, in the context of the transformative change needed for the agriculture sector.

## Rationale of the report

This report focuses on the relationship between sustainable agricultural practices and the concept of Nature-based Solutions (NbS), and specifically the applicability of the IUCN Global Standard for NbS™ to agriculture. IUCN began the process of applying the Standard in different sectors through several publications such as *Integrating Nature-based Solutions into policies for climate change adaptation and disaster risk reduction* (Bisaro & Meyer, 2022), *Planning and delivering Nature-based Solutions in Mediterranean cities* (IUCN, 2021c), *Decent work in Nature-based Solutions 2022* (ILO, UNEP & IUCN, 2022), *Nature-based solutions for climate change mitigation* (UNEP & IUCN, 2021), and *Aquaculture and Nature-based Solutions* (Le Gouvello et al., 2022). This report follows this line and aims to provide clarity on Nature-based Solutions as they relate to agriculture.

The aim is to provide experts and policymakers with ideas, recommendations and concrete uses for these tools, ultimately helping to outline a potential path for a more sustainable future for the agricultural sector. This report looks at the sustainable agricultural approaches and practices identified in the IUCN publication *Approaches to sustainable agriculture* (Oberč & Arroyo Schnell, 2020) in the light of the criteria of the IUCN Global Standard for NbS™ (IUCN, 2020a). It is essential that the criteria established by IUCN are followed and assessed rigorously, in order to avoid potential misinterpretation or misuse of the concept of NbS. This publication is a step in that direction. A series of case studies from all over the world have been integrated to show how NbS can address concrete challenges, providing the reader with real life examples of the multiple benefits of Nature-based Solutions.

By its nature, this is a theoretical exercise, as the implementation on the ground of these practices may differ from the principles upon which they are built. Each intervention is context specific, thus it is not possible to assess a priori whether a particular sustainable agricultural approach is a Nature-based Solution. This report highlights synergies between each approach and the IUCN Global Standard for NbS™, and identifies areas that might need complementary measures in order to bring each approach closer to the concept of Nature-based Solutions.

In addition to this report, the IUCN agriculture guidance for the IUCN Global Standard for Nature-based Solutions will soon be released. This guidance will provide practitioners and project developers with the means to apply the Standard as it would apply to agricultural interventions on the ground. As a result, these two IUCN resources will complement each other by promoting the uptake of the IUCN Global Standard for NbS™ in agricultural contexts.

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# 2. The transition toward sustainable agriculture

The ontological discussion concerning sustainable agriculture has been active for some time. Several institutions and intergovernmental organisations have, over the years, developed various definitions and principles for this branch of agriculture. The most quoted examples are the FAO definition from 1988 (FAO, 1988) and the subsequent FAO principles from 2014 (FAO, 2014), the Royal Society's principles from 2009 (The Royal Society, 2009), as well as the internationally agreed FAO 10 elements of agroecology (FAO, 2018). Elsewhere, there is the report *Agroecological and other innovative approaches* by the High Level Panel of Experts on Food Security and Nutrition of the Committee on World Food Security (HLPE, 2019), the academic work done by Gliessman and Engless (2007), and the nine specific objectives of the reformed EU Common Agricultural Policy, proposed by the European Commission in 2018 (DG AGRI, n.d.).

Recently, IUCN contributed to this debate with the publication of two reports in 2020, titled *Common ground* (Larbodière et al., 2020) and *Approaches to sustainable agriculture* (Oberč & Arroyo Schnell, 2020), both of which have moved the debate forward by mapping a series of agricultural practices that can be considered sustainable. The latter publication identifies 14 approaches to sustainable agriculture (*detailed in Chapter 5*), as well as a list of agricultural practices that can be considered sustainable. The **approaches** identified were:

| | |
|---|---|
| Agroecology | Carbon farming |
| Nature-inclusive agriculture | Climate-smart agriculture |
| Permaculture | High nature value farming |
| Biodynamic agriculture | Low external input agriculture |
| Organic farming | Circular agriculture |
| Conservation agriculture | Ecological intensification |
| Regenerative agriculture | Sustainable intensification |

The list of sustainable agricultural **practices** included:

- **Crop rotation** (FAO, n.d.-e): The practice of alternating the species or families of annual and/or biannual crops grown on a particular field in a planned pattern or sequence so as to break weed, pest, and disease cycles, and to maintain or improve soil fertility and organic matter content.
- **The inclusion of cover and companion crops** (FAO, n.d.-e):
    - *Cover crop*: A crop grown to prevent soil erosion by covering the soil with living vegetation and roots

that hold on to the soil. Cover crops are also grown to help maintain soil organic matter and increase nitrogen availability (green manure crop), and to "hold on" to excess nutrients (a catch crop) still in the soil, following an economic crop. Other benefits of cover crops include weed suppression and attraction of beneficial insects.

- *Companion crop*: One temporary crop planted between rows of another temporary crop.

- **Mixed crop and intercropping** (FAO, n.d.-e): Growing two or more crops in the same field at the same time.
- **The reduction of synthetic pesticide and mineral fertiliser use.**
- **No or minimal tillage** (FAO, n.d.-e): The conservation agriculture practice of drill-seeding with no prior tillage of soil.
- **Lower livestock densities, managed grazing, free range**: allowing animals to roam and move freely, thus creating a renewable cycle wherein the needs of one element are met by the waste of another (Oberč & Arroyo Schnell, 2020).
- **Crop diversification** (FAO, n.d.-e): Species diversification through varied crop associations and/or rotations (involving annual and/or perennial crops including trees).
- **Mixing farming and forestry**: agroforestry can be found under this category. Agroforestry is defined as "a collective name for land-use systems and technologies where woody perennials are deliberately used on the same land-management units as agricultural crops and/or animals, in some form of spatial arrangement or temporal sequence". The three main types of agroforestry systems are agrisilvicultural systems, silvopastoral systems, and agrosylvopastoral systems (FAO, 2015).
- **Mixed crop and animal farming**: Mixing within crop and/or animal systems refers to conditions where multiple cropping is practised, often over time, or where different types of animals are kept together, mostly on-farm (FAO, n.d.-c).
- **Nutrient balancing, recovery and reuse:** "The nutrient balance is defined as the difference between the nutrient inputs entering a farming system (mainly livestock manure and fertilisers) and the nutrient outputs leaving the system (the uptake of nutrients for crop and pasture production)" (OECD, n.d.). Nutrient recovery has been defined as the proportion of nutrients supplied that is taken up by the crop in above-ground parts (WUR, 2019).
- **Inclusion of landscape elements**: Including non-productive elements such as hedgerows and flower strips on farmlands to boost biodiversity and ecosystem services (Oberč & Arroyo Schnell, 2020).

These 14 approaches and the list of sustainable practices detailed above are to be considered the basis of this report and of IUCN's understanding of what is most often considered as sustainable agriculture. Following these examples, it is worth noting that there is a wide spectrum of sustainable agricultural practices that can help to increase farmers' resilience to the threats posed by climate change and biodiversity loss.

According to the FAO, the adoption of NbS interventions that protect natural resources and biodiversity can support the transformation of current agri-food systems into nature positive production systems, while supporting farmers (Iseman & Miralles-Wilhelm, 2021). NbS can be applied, inter alia, for soil health, climate change mitigation and adaptation, enhancing water quality, biodiversity benefits as well as agricultural production and supply chains to achieve net-zero environmental impacts while achieving food and water security and meet climate goals (Miralles-Wilhelm, 2023).

Nature-based Solutions are context and location dependent, it is therefore important for this report to investigate several approaches practices which can be applied to the variable contexts in which NbS may be implemented. What can work in one country or region might not be the suitable in another. Nevertheless, all the agricultural practices outlined here are, in most cases, more sustainable than conventional ones.

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# 3. What are Nature-based Solutions?

## 3.1. History of the concept and IUCN's leadership

'Nature-based Solutions' is an umbrella term that draws on a wide range of pre-established concepts". This includes primarily the Ecosystem-based Approach[2], but also ecological engineering, forest landscape restoration, ecological restoration and eco-disaster risk reduction (Cohen-Shacham et al., 2016; Seddon et al., 2020b).

The term first appeared in a 2008 report by the World Bank titled *Biodiversity, Climate Change, and Adaptation Nature-Based Solutions from the World Bank Portfolio* (MacKinnon, Sobrevila & Hickey, 2008). This was the first time that the term entered the scientific and policy discourse. It was an attempt to create an overarching term capable of highlighting the role of nature in the fight against climate change. In the World Bank report one subchapter is dedicated to climate adaptation in agricultural landscapes, in which initiatives to adapt to changing weather patterns by using agrobiodiversity resources are outlined (MacKinnon, Sobrevila & Hickey, 2008).

Since its conception, the International Union for Conservation of Nature has been a leader and a pioneer in this field. NbS were first included in an IUCN official document in a 2009 Members' briefing in preparation for the 15th Conference of the Parties of the United Nations Framework Convention on Climate Change (UNFCCC COP15) (Cohen-Shacham et al., 2016; IUCN, 2009). There IUCN identified NbS as "a global policy priority for the UNFCCC" and called for the inclusion of Ecosystem-based Adaptation (EbA) in the adaptation framework of the post-2012 climate change agreement (IUCN, 2009).

Shortly after, Nature-based Solutions were incorporated in the IUCN 2013-2016 Programme Area "*Deploying nature-based solutions to global challenges in climate, food and development*" (IUCN, 2012). IUCN acknowledged that food security, climate change, and economic and social development have a deep impact on the status and trends of ecosystems, species, and genetic resources (IUCN, 2012). As an action for that programmatic period IUCN stated that it would: "*Identify opportunities to pilot ecosystems-based approaches in conjunction with established food security strategies, enhancing the stability of production and utilisation*". Once again, it is clear that NbS have been associated with food systems since their earliest developments.

Between 2009 and 2014 there were other key milestones for the development of Nature-based Solutions (Cohen-Shacham et al., 2016). In 2010 the joint report *Natural Solutions: Protected areas helping people cope with climate change* was launched (Dudley et al., 2010), and in 2014 a workshop

2 "The Ecosystem Approach is a strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way. The Ecosystem Approach places human needs at the centre of biodiversity management. It aims to manage the ecosystem, based on the multiple functions that ecosystems perform and the multiple uses that are made of these functions. The ecosystem approach does not aim for short-term economic gains, but aims to optimise the use of an ecosystem without damaging it." (SCBD, n.d.).

on 'Nature-Based Solutions in a BiodivERsA context' was organised (BiodivERsA, 2014).

In 2015, the European Commission (EC) defined NbS as: "*Solutions that are inspired and supported by nature, which are cost-effective, simultaneously provide environmental, social and economic benefits and help build resilience. Such solutions bring more, and more diverse, nature and natural features and processes into cities, landscapes and seascapes, through locally adapted, resource-efficient and systemic interventions*." (EC, n.d.; Maes & Jacobs, 2017).

The scientific expertise of IUCN, the political will to elevate Nature-Based Solutions to the forefront of environmental policy discourse, and the work of IUCN Members led to the adoption of a formal definition at the World Conservation Congress in 2016. Through Resolution 6.069, IUCN Members voted to define NbS as **"actions to protect, sustainably manage, and restore natural or modified ecosystems, that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits**" (IUCN, 2016). Complimentary to this decision, IUCN also published its ground-breaking report *Nature-based Solutions to address global societal challenges* where the concept was further elaborated, and practical case studies were presented (Cohen-Shacham et al., 2016).

While IUCN's definition focuses on well-managed or restored ecosystems in any NbS, the European Commission definition is broader and covers solutions inspired and supported by nature (Cohen-Shacham et al., 2016). The operationalisation of both definitions, however, stresses the importance of biodiversity (Sowińska-Świerkosz & García, 2022). Indeed, the EC's understanding of NbS underscores that "Nature-based Solutions must benefit biodiversity and support the delivery of a range of ecosystem services" (EC, n.d.).

Later, in 2020, IUCN continued to pave the way towards broader uptake, a deeper scientific understanding, and a clearer implementation of NbS through the release of the IUCN Global Standard for Nature-based Solutions™ (IUCN, 2020a). Building on the principles from its earlier publications, IUCN developed a user-friendly framework for the verification, design and scaling up of NbS. This internationally recognised standard answered two fundamental questions from the international community of practitioners and policy makers. On one hand, it provided more clarity on the concept by elaborating 8 criteria to determine whether an action can be considered an NbS. On the other hand, through the *Guidance for using the IUCN Global Standard for Nature-based Solutions* (IUCN, 2020b), it created a roadmap for practitioners to implement and assess NbS.

Lastly, an international resolution was adopted at the Fifth Session of the United Nations Environment Assembly in March 2022 (UNEA, 2022). After extensive negotiations Member States agreed on a multilateral definition of Nature-based Solutions:

> "*actions to protect, conserve, restore, sustainably use and manage natural or modified terrestrial, freshwater, coastal and marine ecosystems, which address social, economic and environmental challenges effectively and adaptively, while simultaneously providing human well-being, ecosystem services and resilience and biodiversity benefits*."

Much of the wording used here is based on the IUCN definition, albeit with an enhanced focus on sustainable use and economic challenges. IUCN welcomed this decision (Peña Moreno, 2022) and applauded the Parties for acknowledging the need to strengthen the joint climate-biodiversity agenda through the implementation of NbS at scale.

## 3.2. Theoretical overview

According to the IUCN Global Standard for Nature-based Solutions™, an intervention must address one of these seven societal challenges while not hindering the achievement of the others in order to be considered an NbS (IUCN, 2020a):

- climate change adaptation and mitigation;
- disaster risk reduction;
- reversing ecosystem degradation and biodiversity loss;
- human health;
- socioeconomic development;
- food security; and,
- water security.

Furthermore, if the societal challenge concerns ecosystem degradation and biodiversity loss, the intervention must address an additional societal challenge from the list. This criterion has been included to avoid every conservation action being automatically considered a Nature-based Solution (Cohen-Shacham et al., 2016). Furthermore, Nature-based Solutions should not be confused with nature-derived and nature-inspired solutions. The former does not rely on functioning ecosystems, but derives energy from natural resources: one example is wind farms. The latter includes materials, structures and systems that are inspired by biological processes (Cohen-Shacham et al., 2016), for example biomimicry.


**Fig. 1** Defining Nature-based Solutions

In the early stages of the conceptual development of NbS, before the development of the Guidance for using the IUCN Global Standard for NbS (IUCN, 2020b), BiodivERsA ERA-NET proposed a typology of Nature-based Solutions interventions (Eggermont et al., 2015). It is built on two gradients: on one axis there is the level of engineering applied to biodiversity and ecosystem, on the other the level of enhancement of ecosystem services achievable by the NbS is highlighted. Three types of NbS were identified:

- **Type 1**: no or minimal intervention in ecosystems, the goal is to maintain and enhance the delivery of ecosystems services within and outside preserved ecosystems.

- **Type 2:** this refers to the development of management practices that create multi-functional ecosystems and landscapes (extensively or intensively managed) that are deemed sustainable. In this category, the authors included "innovative planning of agricultural landscapes to increase their multifunctionality" and linked the typology to concepts like natural systems agriculture and agroecology.

- **Type 3**: includes heavily modified or novel ecosystems and it is frequently linked to concepts such as green and blue infrastructure.

This typology stipulated that while Type 1 Solutions are aligned with the IUCN definition, Type 2 and 3 Solutions needed to show that they contribute to biodiversity conservation and ecological connectivity. It must be mentioned that this typology came before the Guidance for using the IUCN Global Standard for NbS (IUCN, 2020b). These three typologies have subsequently evolved, for example Type 1 Solutions now need to address another societal challenge to be considered an NbS by IUCN. This classification system was highly influential and was later adapted to the particular context of agriculture in a joint FAO-TNC publication (Iseman & Miralles-Wilhelm, 2021) and by some academic papers (Simelton et al., 2021).

A further consideration is that NbS are defined as "actions", thus the omission of an action (e.g. avoided deforestation) cannot be considered an NbS within the meaning of the IUCN definition.

Nature-based Solutions are not substitutes nor alternatives to nature conservation, they can, however, be complementary actions to conservation efforts. Moreover, biodiversity protection is deeply embedded in the concept of NbS, therefore actions that do not maintain or enhance biodiversity, or set and monitor biodiversity outcomes, cannot be considered Nature-based Solutions (Sowińska-Świerkosz & García, 2022). This principle is necessary for the prevention of improper implementation of NbS. Through this, any disregard of the scientific criteria underpinning the concept is avoided and provides a more complete understanding of NbS as an answer to some critics who consider NbS to be a potential distraction from climate action.

Indeed, in recent years two opposing narratives surrounding NbS have been identified by scholars: "NbS leveraging the power of nature" and "NbS as a dangerous distraction" (Melanidis & Hagerman, 2022). While this study would fit in the former narrative, highlighting the potential that NbS have in bridging biodiversity and climate considerations with the agricultural discussion, it is important to acknowledge the criticisms. Those who doubt NbS view them as a tool for greenwashing and as a way to allow destructive practices and power-relations to continue under the guise of sustainable actions (Melanidis & Hagerman, 2022). However, if Nature-based Solutions are applied in compliance with the IUCN definition, principles, and tools, as well as

the IUCN Global Standard for NbS™, the conceptual ambiguity that gives rise to such concerns can be mitigated. The concept of NbS and the science surrounding the term is constantly evolving; thus, the lack of detailed criteria for NbS is being solved through a growing body scientific literature (Sowińska-Świerkosz & García, 2022), in particular the IUCN Global Standard for Nature-based Solutions™.

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# 4. Applying the IUCN Global Standard for NbS™ to agriculture

To ensure that Nature-based Solutions deliver to their full potential and are not misused, IUCN developed the IUCN Global Standard for NbS™ in 2020. The Standard builds on the IUCN NbS definition and on the eight underlying principles outlined in IUCN's publication "Nature-based Solutions to address global societal challenges" of 2016 (Cohen-Shacham et al., 2016). The goals of the Standard are manifold. It aims to provide a common understanding of what NbS are, to ensure that the implementation of NbS is carried out systematically, to promote a transparent deployment process, and to accelerate policy development. Furthermore, the Standard provides a learning framework capable of improving the application of NbS over time while fostering rich academic debate on the topic (IUCN, 2020a). The Standard currently has two functions: to guide the design of an NbS, and to provide a means of verifying that the design of a particular solution meets the IUCN criteria in order to be considered an NbS.

The IUCN Global Standard for NbS™ is not a silver bullet, nor is it a one-size fits all solution that can be applied indiscriminately to all contexts. IUCN stresses that it is aimed at promoting a wider uptake, while improving design and execution, instead of demanding the achievement of specific results (IUCN,

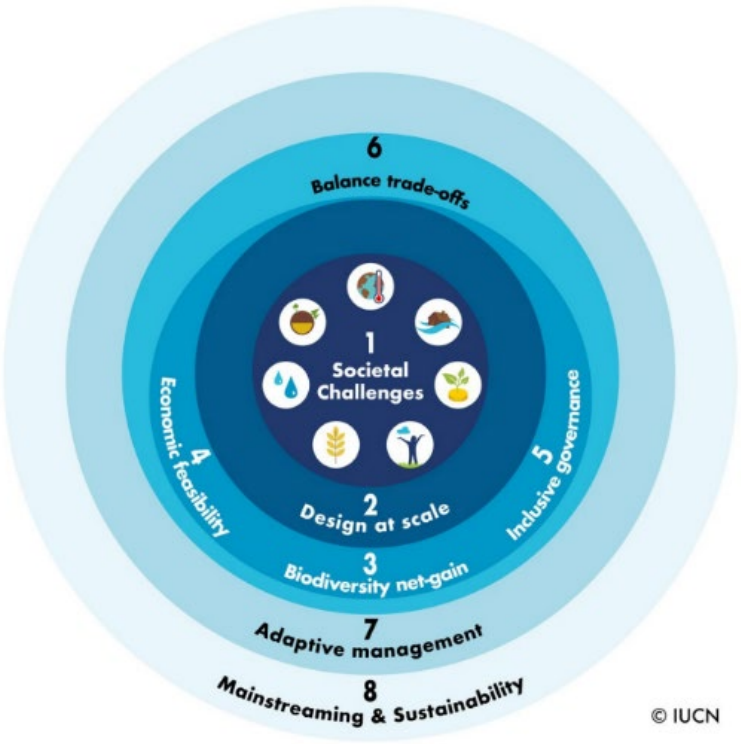


**Fig. 2** The interlinkages of the eight Criteria of the IUCN Global Standard for NbS™

2020a). It is designed for national, regional, municipal, and local governments, planners, businesses, donors, financial institutions including development banks and non-profit organisations. **Each NbS is context-specific, it needs to take the ecological composition of the location in which it will be implemented, the actors and right holders that must be involved in the designation and management process, and the cultural background of the entire socio-economic system into consideration** (IUCN, 2020a).

The Standard includes eight criteria and twenty-eight indicators (which can be assessed as insufficient, partial, adequate, or strong), these are:

1. **NbS effectively address societal challenges**
   - 1.1. The most pressing societal challenge(s) for rights-holders and beneficiaries are prioritised
   - 1.2. The societal challenge(s) addressed are clearly understood and documented
   - 1.3. Human well-being outcomes arising from the NbS are identified, benchmarked and periodically assessed

2. **Design of NbS is informed by scale**
   - 2.1. The design of the NbS recognises and responds to interactions between the economy, society and ecosystems
   - 2.2. The design of the NbS is integrated with other complementary interventions and seeks synergies across sectors
   - 2.3. The design of the NbS incorporates risk identification and risk management beyond the intervention site

3. **NbS result in a net gain to biodiversity and ecosystem integrity**
   - 3.1. The NbS actions directly respond to evidence-based assessment of the current state of the ecosystem and prevailing drivers of degradation and loss
   - 3.2. Clear and measurable biodiversity conservation outcomes are identified, benchmarked and periodically assessed
   - 3.3. Monitoring includes periodic assessments of unintended adverse consequences on nature arising from the NbS
   - 3.4. Opportunities to enhance ecosystem integrity and connectivity are identified and incorporated into the NbS strategy

4. **NbS are economically viable**
   - 4.1. The direct and indirect benefits and costs associated with the NbS, who pays and who benefits, are identified and documented
   - 4.2. A cost-effectiveness study is provided to support the choice of NbS including the likely impact of any relevant regulations and subsidies
   - 4.3. The effectiveness of the NbS design is justified against available alternative solutions, taking into account any associated externalities
   - 4.4. NbS design considers a portfolio of resourcing options such as market-based, public sector, voluntary commitments and actions to support regulatory compliance

5. **NbS are based on inclusive, transparent and empowering governance processes**
   - 5.1. A defined and fully agreed upon feedback and grievance resolution mechanism is available to all stakeholders before an NbS intervention is initiated
   - 5.2. Participation is based on mutual respect and equality, regardless of gender, age or social status, and upholds the right of Indigenous Peoples to Free, Prior and Informed Consent (FPIC)
   - 5.3. Stakeholders who are directly and indirectly affected by the NbS have

been identified and involved in all processes of the NbS intervention

5.4. Decision-making processes document and respond to the rights and interests of all participating and affected stakeholders

5.5. Where the scale of the NbS extends beyond jurisdictional boundaries, mechanisms are established to enable joint decision-making of the stakeholders in the affected jurisdictions

**6. NbS equitably balance trade-offs between achievement of their primary goal(s) and the continued provision of multiple benefits**

6.1. The potential costs and benefits of associated trade-offs of the NbS intervention are explicitly acknowledged and inform safeguards and any appropriate corrective actions

6.2. The rights, usage of and access to land and resources, along with the responsibilities of different stakeholders, are acknowledged and respected

6.3. The established safeguards are periodically reviewed to ensure that mutually agreed trade-off limits are respected and do not destabilise the entire NbS

**7. NbS are managed adaptively, based on evidence**

7.1. A NbS strategy is established and used as a basis for regular monitoring and evaluation of the intervention

7.2. A monitoring and evaluation plan is developed and implemented throughout the intervention lifecycle

7.3. A framework for iterative learning that enables adaptive management is applied throughout the intervention lifecycle

**8. NbS are sustainable and mainstreamed within an appropriate jurisdictional context**

8.1. The NbS design, implementation and lessons learnt are shared to trigger transformative change

8.2. The NbS informs and enhances facilitating policy and regulation frameworks to support its uptake and mainstreaming

8.3. Where relevant, the NbS contributes to national and global targets for human well-being, climate change, biodiversity and human rights, including the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP)

**All of the criteria of the IUCN Global Standard for NbS™ are fundamental, meaning that all of them must be met for an intervention to be considered a Nature-based Solution in accordance with IUCN**. By nature, sustainable agriculture tackles different societal challenges (Criterion 1) and is informed by the scale and jurisdictional context in which it operates (Criteria 2 and 8). Criterion 3 on biodiversity net-gain and ecosystem integrity, Criterion 4 on economic viability, and Criterion 5 on inclusive governance reflect the three key dimensions of sustainable development. At the same time, while implementing an NbS it is important to consider the trade-offs between the primary goal and other benefits (Criterion 6); as well as ensuring an adaptive management plan (Criterion 7).

Practitioners looking for a more technical instrument for the implementation of agricultural NbS can refer to the IUCN guidance for NbS in agriculture for projects, due to be published in 2025.

## 4.1. Criterion 1: NbS effectively address societal challenges

Statistics regarding the extent of the biodiversity crisis indicate that we are at a critical juncture. For example, there are one million species at risk of extinction (IPBES, 2019) and there has been a 69% average decline in wildlife populations over the past fifty years (WWF, 2022). Equally, data on the impact of unsustainable agricultural practices reflect this global trend, while receiving more limited attention. For instance, between 18 and 33% of agricultural lands currently have insufficient biodiversity to provide key ecosystem services, such as pollination, biological pest control, climate regulation, and the prevention of soil erosion, nutrient loss, and water contamination (SCBD, 2022). The reliance on reduced biodiversity for the provision of food, feed, and fibre makes the food system extremely vulnerable to threats such as pests, pathogens, and climate change, posing a serious risk of global food security (IPBES, 2019).

Criterion 1 of the IUCN Global Standard for NbS™ states that NbS should be developed to address specific societal challenges. It includes three indicators:

- **C-1.1**. The most pressing societal challenge(s) for rights-holders and beneficiaries are prioritised
- **C-1.2.** The societal challenge(s) addressed are clearly understood and documented
- **C-1.3.** Human well-being outcomes arising from the NbS are identified, benchmarked and periodically assessed

Looking at the list of societal challenges that NbS address (climate change adaptation and mitigation, disaster risk reduction, ecosystem degradation and biodiversity loss, human health, socio-economic development, food security and water security), it is clear that sustainable agricultural practices could potentially address most of them. For indicator 1.1., it is important, that an inclusive consultation process with all right-holders and beneficiaries is carried out, when designing an intervention (in line also with Criterion 5 and 7). At the same time, it is key that an NbS intervention defines clear targets for human well-being outcomes, in line with Indicator 1.3.

With regards to Indicator 1.2, the scientific evidence on the impacts of unsustainable agriculture on our planet is well documented. From the soil below us to the air we breathe, agriculture has deep impacts on nature at all levels. Soil biodiversity is negatively impacted by the industrialisation of agriculture and the increase in inputs in order to maintain the current level of productivity. According to the FAO, 33% of land is moderately to highly degraded (FAO & ITPS, 2015) and on the current trajectory 90% of all soils are set to be degraded by 2050 (FAO, 2022c-e). This is due to, amongst other causes, acidification and chemical pollution of soils. In addition, microplastic contamination on land is estimated to be 4 to 32 times higher than in the ocean and it is estimated that farmlands in Europe and North America alone have an estimated yearly input of 63,000-430,000 and 44,000-300,000 tonnes of microplastics, respectively (Gionfra, 2018).

Fertilizer use has increased by a factor of five between 1961 and 2018 worldwide, and pesticide use has doubled since 1990 (Benton et al., 2021). It is estimated that if current trends in land use change, urbanisation, pollution (especially from pesticides and fertilisers), climate change, and invasive alien species continue, around 40% of insect species will at risk of extinction in the next few decades (Benton et al., 2021; Sánchez-Bayo & Wyckhuys, 2019). The contamination of the agricultural land, coupled with the ongoing climate crisis and soil degradation, will decrease the resilience of our soils and cause a decline in agricultural productivity, modify the plant species mix and contribute

to the decline of biodiversity (IPCC, 2019). However, good soil and landscape management can address these threats while providing extensive environmental, social, and economic benefits. In September 2020, IUCN published a report titled "Common Ground" (Larbodière et al., 2022), which aimed to highlight the potential of soil and landscape biodiversity in the fight against climate change and biodiversity loss.

Recent reports have shown that food production is the primary cause of biodiversity loss globally. This is primarily due to land-use change, with cropping and animal husbandry occupying almost 50% of the total habitable land (Benton et al., 2021). Unsustainable food systems are responsible for 80% of deforestation (IPBES, 2019; UNCCD, 2022b). The current food system has changed the composition of our planet and dramatically altered the fragile balance of the planet's ecosystems. Presently, farmed animals account for 60% of global mammal biomass, compared to the 4% representing the total biomass of all wild mammals. Beyond mammals, farmed chickens represent 57% of all bird species by mass (Benton et al., 2021). Additionally, the global decline in farmland birds can be attributed partly to the intensive model of agriculture. In Europe the decline has been around 17% since the year 2000 (Eurostat, 2021).

Globally, only 9 of the ~382,000 species of vascular plants account for over 66% of all crop production by weight. Moreover, 26% of the 7,745 local breeds of livestock are classified as at risk of extinction (Bélanger & Pilling, 2019).

The effect that agriculture has on water resources must also be mentioned. 70% of freshwater use is dedicated to agriculture and in many cases chemical run-off from excessive inputs at farm level can negatively impact wildlife. Since the 1970s, an 84% decline in freshwater species population has been recorded (WWF, 2022).

Lastly, agriculture, forestry, and other land use (AFOLU) is one of the main contributors to anthropogenic greenhouse gas emissions, with an estimated contribution of 23% to the total, and this is projected to increase. The emissions deriving from animal-based foods account for 75% of that figure. These data directly correlate with the impacts of climate change on agriculture. Globally, 26% of the total loss and damage from climate-related disasters are within the agricultural sector (Carter et al., 2021). Furthermore, extreme weather events, global warming, and changes in precipitation patterns have and will continue to affect food security with increasing frequency and intensity, endangering the stability of the food supply chain. In addition, the increasing atmospheric CO2 levels can also lower the nutritional quality of crops (IPCC, 2019).

## 4.2. Criterion 2: Design of NbS is informed by scale

Criterion 2 looks at the social and ecological interactions within which an NbS intervention is designed and implemented. The three indicators for Criterion 2 are:

- **C-2.1.** The design of the NbS recognises and responds to interactions between the economy, society and ecosystems
- **C-2.2.** The design of the NbS is integrated with other complementary interventions and seeks synergies across sectors
- **C-2.3.** The design of the NbS incorporates risk identification and risk management beyond the intervention site

On indicator 2.1, it is important to keep in mind that in the agricultural context each agroecosystem is a crucial piece of a more complex mosaic of diverse land uses and its management can and does directly affects their surroundings. For that reason, a landscape approach is not only needed but necessary. In this regard, the report "Foodscapes: Toward Food System Transition" by The Nature Conservancy and partners is quite interesting (Bossio et al., 2021). In their analysis, the authors define foodscape as: "*a geographic location characterised by a distinct combination of food production management characteristics, and the biophysical attributes of the wider land- and seascapes within which it is embedded. The foodscape, as a unit, encourages an integrated perspective, and mapping foodscapes based on globally available data sets provides a spatially explicit platform for interventions*" (Bossio et al., 2021). This understanding is clearly in line with the principles underpinning Criterion 2. In addition, the Foodscapes report states that Nature-based Solutions are central to a sustainable transition in our food systems and have the potential to transform the world's foodscapes, helping restore ecological function and the resilience on land and at sea (Bossio et al., 2021).

For indicator 2.2. the Guidance for using the IUCN Global Standard for Nature-based Solutions (IUCN, 2020b) interestingly mentions the coupling of NbS interventions with sustainable agricultural practices to better address food security. It also uses the example of nutrient recycling when looking at how some interventions must be managed at both intervention and landscape level.

The last indicator in this criterion aims to ensure that risk identification and risk management beyond the intervention are duly taken into account. Since Nature-based Solutions are context-dependent, failing to consider their negative externalities across scales might hinder their success and might increase the vulnerability of some stakeholders. Here the integrity of the IUCN Global Standard for NbS™ becomes fundamental and the Criterion 2 considerations are integrated in the assessments of Criterion 3, 4, 5, 6, and 8.

## 4.3. Criterion 3: NbS result in a net gain to biodiversity and ecosystem integrity

Healthy ecosystems are at the core of healthy agriculture. In implementing an NbS in an agricultural context, biodiversity, including agrobiodiversity, must be at the core of the intervention. The NbS must not only provide a net biodiversity gain, they must also set and monitor biodiversity conservation outcomes (Sowińska-Świerkosz & García, 2022). This is particularly important in light of the impact conventional agriculture has on agroecosystems and biodiversity in general. Furthermore, as it will be explained later in this section, ecosystem integrity is of paramount importance for this criterion, especially since agroecosystems are just one component of a much more complex and diverse landscape.

The explanation of Criterion 3 in the IUCN Guidance to the Global Standard for NbS (IUCN, 2020b) states that:

> "*NbS should aim to conserve or restore ecosystem integrity and avoid further simplifying an ecosystem (such as replacing natural mixed woodland with a monoculture tree plantation)…NbS depend on the ecological condition of the supporting ecosystems; therefore, it is in the interest of the NbS practitioner*

> *to ensure that implementation measures will, at the least, maintain the ecological integrity of the target area over the long term*."

This explanation underscores how, in IUCN's conceptualisation of Nature-based Solutions, conserving nature is fundamental. The criterion is divided into four indicators:

- **C-3.1.** The NbS actions directly respond to evidence-based assessment of the current state of the ecosystem and prevailing drivers of degradation and loss
- **C-3.2.** Clear and measurable biodiversity conservation outcomes are identified, benchmarked and periodically assessed
- **C-3.3.** Monitoring includes periodic assessments of unintended adverse consequences on nature arising from NbS
- **C-3.4.** Opportunities to enhance ecosystem integrity and connectivity are identified and incorporated into the NbS strategy

In the first indicator, IUCN acknowledges that due to their high costs, surveys and data collection about baselines and ecosystems services are often focused only on certain indicators (IUCN, 2020b). In the further implementation of NbS globally, it will be key for developed countries to provide financial, technical, and technological assistance to developing country. Limited capacity to gather key data could potentially hinder the uptake of NbS. As a result, capacity development should be at the heart of NbS financing. On the other hand, in scenarios where resources allow for solid data collection, it is important to ensure the reliability of the scientific assessment at the basis of Criterion 3.

To guide practitioners in this initial stage of NbS deployment, IUCN has developed assessment criteria, requiring certain sets of data. This includes structural information of the ecosystem, species composition, information on key ecosystem functions, key aspects of the physical environment, connectivity, external threats to the ecosystem and risk of collapse for ecosystems, as well as existing/ongoing conservation interventions for the species and ecosystems at risk in the landscape/seascape.

Assessing the impact of Nature-based Solutions on biodiversity will require sound methods. According to an upcoming IUCN Europe report on biodiversity assessment methods for agriculture, many methods have been developed to assess biodiversity status and the impact of human activities, including agriculture. However, while they might be useful for some purposes such as public awareness or helping businesses and farmers to track their progress towards sustainability transition, most of them are not well-suited to assess NbS, as they do not consider biodiversity significance, and many do not have validation systems in place. An exception is the Species Threat Abatement and Restoration (STAR) metric (Hawkins et al., 2023; IUCN, n.d.-b), a bottom-up method that allows to assess the impact and effectiveness of biodiversity conservation actions. This could be very useful to assess the impact of NbS on biodiversity, specifically their contribution to reducing species extinction risk. This type of assessment is applicable at different levels: site, company, or country level. To support this work IUCN will continue to develop key supporting publications and tools, such as the Land Health Monitoring Framework (Dussán López, 2023). Moreover, IUCN tools and standards are fundamental in these monitoring and assessing endeavours, in particular the IUCN Red List of Threatened Species and of Ecosystems, and the IUCN Global Ecosystem Typology.

In addition, those seeking to implement an NbS can use available datasets or information that have been compiled for other purposes. In Europe, for example, the European Environment Agency's State of Nature report collects a vast array of relevant data

that can be disaggregated to national and sometimes regional levels.[3] In other regions of the world, reporting is derived from the UN Convention on Biological Diversity, through the National Biodiversity Strategies and Action Plans (NBSAPs), which can also be helpful in fulfilling indicator 3.1. Data from different agricultural institutions, such as FAO or the International Fund for Agricultural Development (IFAD), could also be of help in setting this baseline. If the NbS intervention aims to restore an ecosystem, the FAO, IUCN Commission on Ecosystem Management and the Society for Ecological Restoration recently released the publication on "Standards of practice to guide ecosystem restoration" (Nelson et al., 2024). This document provides key recommendations to maximise restoration outcomes for nature and people, including in production ecosystems.

Indicator 3.2 stresses the importance of establishing conservation targets, through an inclusive and transparent process. As a minimum each target regarding conservation and/or restoration should outline specific measurable variable(s) associated with the management target (e.g. number of species/ha, % canopy cover); action (e.g. increase, decrease, or maintain); quantity, and time-period. In addition, the more these targets are aligned with existing regional or international commitments, the easier it will be for the NbS to achieve Criterion 8 (NbS are sustainable and mainstreamed within an appropriate jurisdictional context) simultaneously. The challenge of developing farm-based targets could be overcome by not only looking at the individual farm level but as an entity in a wider ecosystem and to link their performance with regional or national targets.

Indicator 3.3 focuses on monitoring the possible negative impacts of NbS deployment. According to the guidance of IUCN (2020b), monitoring and evaluation plans should mention: the amount and sources of funding for each component of the monitoring programme, the design for data collection, the method of data collection, the replication needed to determine the effects of management interventions, frequency and duration of monitoring; the types of analysis that will be used to evaluate the effects of management; the location and protocols for managing and creating a permanent archive of data; the manner in which lessons learned will be shared. In the agricultural context, this information could be gathered by individual farmers and shared through pre-existing networks, farming organisations and cooperatives.

Lastly, indicator 3.4 places an added emphasis on connectivity. This component reflects the deep linkages which NbS have with the concept of green and blue infrastructures. It also highlights the importance of ecological corridors and ecosystem integrity for biodiversity. There is a growing body of literature researching the role of agroecosystems in habitat connectivity, for example through spatial mapping models (Suraci, 2023), agroecological approaches (WWF, 2021), or by analysing the role of constructed wetlands (Ferreira et al., 2023). Since agricultural expansion is one of the main drivers of habitat loss and fragmentation (Tilman et al., 2017), this indicator is particularly important in planning and implementing Nature-based Solutions in agricultural landscapes.

The impact that agriculture has on biodiversity and its reliance on healthy ecosystems makes it so that Criterion 3 gains a prominent role in this context. Nature-based Solutions that fail to comply with this criterion cannot qualify as such.

3 This data is collected on the basis of reporting requirements under the Birds and Habitats Directives.

## 4.4. Criterion 4: NbS are economically viable

To be considered a Nature-based Solution, interventions must be economically viable, as indicated in Criterion 4 of the IUCN Global Standard for NbS™. Farmers, landowners, and other agricultural stakeholders require solutions that not only address environmental or societal challenges, but that also provide lasting economic stability. For that, there is the need for a shift in thinking from short-term to long-term planning. Indeed, the goal of NbS is not only to provide immediate benefits and impact, they must also aim to be economically viable beyond the timeframe of the initial intervention (IUCN, 2020b).

The IUCN Global Standard for Nature-based Solutions™ captures the need for economic viability through Criterion 4, which in turns includes four indicators:

- **C-4.1**. The direct and indirect benefits and costs associated with the NbS, who pays and who benefits, are identified and documented
- **C-4.2**. A cost-effectiveness study is provided to support the choice of NbS including the likely impact of any relevant regulations and subsidies
- **C-4.3**. The effectiveness of the NbS design is justified against available alternative solutions, taking into account any associated externalities
- **C-4.4**. NbS design considers a portfolio of resourcing options such as market-based, public sector, voluntary commitments and actions to support regulatory compliance

Critics have raised the concern that NbS present high upfront costs and short-term risks, which act as a barrier to NbS adoption and promote more environmentally damaging business as usual practices (Iseman & Miralles-Wilhelm, 2021). The arguments, however, fail to consider that the repercussions of biodiversity loss and climate change are already having a detrimental impact on business. In the agricultural sector, continuing harmful practises will negatively impact farmers and their economic stability world-wide. For example, it is estimated that the global loss of pollinators would lead to a drop of USD 235 billion to USD 577 billion in annual agricultural output (IPBES, 2019), as 75% of all crops rely on pollinators (FAO, 2018b). NbS should thus be seen as an investment rather than a cost.

Currently, NbS are heavily underfunded (Seddon et al., 2020a): despite providing around one third of the climate change mitigation required, estimates calculate that only 3% of climate financing is currently directed towards Nature-based Solutions (IUCN, 2021; Macquarie et al, 2020). The Executive Director of UNEP, Inger Andersen, called for a threefold increase in finance for Nature-based Solutionsin order to meet global environmental targets (UNFCCC, 2022a).

Within our economic system there are several tools that could scale up the deployment of Nature-based Solutions and ensure that environmental conservation receives the necessary funding. A reform in tax policy geared towards biodiversity conservation, green financial instruments, true cost accounting[4], benefit-sharing mechanisms, philanthropy, and certification schemes are all instruments that could contribute to filling the biodiversity finance gap, which currently stands between USD 598–824 billion per year (Deutz et al., 2020). However, the single-most impactful reform would be to

4 True Cost Accounting in food and agriculture internalises negative and positive externalities. Our food systems have in many instances detrimental consequences on environmental and human health, but these impacts are not accounted for (Sustainable Food Trust, n.d.). In recent years, several initiatives have begun working on this issue in order to shed a light on the nexus between the global agri-food sector externalities and biodiversity. One notable example is the work by the Global Alliance for the Future of Food and UN Environment Programme on the Economics of Ecosystems and Biodiversity for Agriculture and Food Initiative and the TEEBAgriFood Framework (Global Alliance for the Future of Food, n.d.).

rework governmental subsidies to take better account of biodiversity.

Indeed, governments could support NbS in agriculture by repurposing subsidies to encourage sustainable management practices, support training programmes and help to secure tenure rights (Miles et al., 2021). This last point is critical, especially for Indigenous people (IP), as some experts have outlined how unclear tenure rights could pose a major risk to indigenous peoples themselves and for investment (FAO, 2022b).

NbS operate in a broader economic context, therefore through the redistribution of existing harmful subsidies and the establishment of new financial mechanisms, the short-term costs of NbS could be mitigated if not abated. National and subnational spending on activities harmful to biodiversity is around USD 274–542 billion per year (in 2019) and that is two to four times higher than biodiversity conservation spending (Deutz et al., 2020). In the agricultural sector alone around USD 700 billion is paid out in subsidies each year, but only around 15% of this amount positively impacts natural capital, biodiversity, long-term job stability, or livelihoods (UNCCD, 2022b). An OECD analysis found that across 54 economies, USD 345 billion in agricultural support (2017–2019 average) was provided every year for activities that undermine the sector's sustainability (OECD, 2021). The Dasgupta Review found that subsidies which are harmful to the environment vastly outweigh those that benefit it, and that further reporting on these governmental support measures is needed in order to truly understand their environmental impact (Dasgupta, 2021).

The newly adopted Kunming-Montreal Global Biodiversity Framework took an important step towards tackling the issue on unsustainable subsidies. Target 18 reads:

> "*Identify by 2025, and eliminate, phase out or reform incentives, including subsidies, harmful for biodiversity, in a proportionate, just, fair, effective and equitable way, while substantially and progressively reducing them by at least 500 billion United States dollars per year by 2030, starting with the most harmful incentives, and scale up positive incentives for the conservation and sustainable use of biodiversity*" (CBD, 2022).

Implementation of this target will be challenging, however several initiatives are already making progress, such as the OECD's efforts in identifying and assessing subsidies and other incentives harmful to biodiversity (Matthews & Karousakis, 2022).

It is important to note that the figures indicated largely refer to the Global North. It would therefore be important for wealthier nations to support the financing of NbS in the Global South through existing instruments such as the Global Environment Facility and the newly established Global Biodiversity Framework Fund (GEF, 2023).

This transformative change, however, should not be considered a burden, but as an economically and financially wise decision for the long-term. For each dollar invested in ecosystem restoration the return in economic benefits has been calculated at around between USD 7-30 (Verdone & Seidl, 2017). Moreover, recent studies have highlighted that the returns from a regenerative restoration economy, that would tackle the environmental crises of today, are estimated to be USD 125-140 trillion annually, almost one and a half times the global GDP (Benton et al., 2021). Transitioning to a more sustainable agricultural model is necessary and one of the most promising ways to achieve this is by working together with nature and harnessing its potential. Healthy ecosystems are the only way to ensure a future for the agricultural sector.

## 4.5. Criterion 5: NbS are based on inclusive, transparent and empowering governance processes

Small farms are quickly disappearing. A study conducted by the European Parliament projected a decrease in the number of EU farms from 10 to 4 million by 2040, with increases in farm size and/or farming intensity as dominant adaptation strategies for those farms which remain (Rossi, 2022). According to the FAO, 70% of all agricultural land is already held by only 1% of farmers, indicating a disproportionate division of resources (FAO, 2021). Simultaneously, most of the agri-related subsidies that were described in the previous chapter tend to favour larger companies and one particular model of conventional agriculture. For example, in the European Union, 80% of the EU money for agriculture goes to the largest 20% of farmers (HU, 2019). To transition towards a sustainable food system, it is important to ensure that smallholder farmers are central to the new model and that their rights are upheld.

Guaranteeing the right distribution of resources is not only a matter of social justice, it is also key for environmental justice. The effects of the ongoing environmental crisis will have disproportionately and uneven impacts on vulnerable groups and nations. Those in the Global South are more likely to suffer from climate change and biodiversity loss. Smallholder farmers in these regions often have limited adaptation capacity due to low education levels, low income, limited land areas, and poor access to technical assistance, market and credits, and often have a chronic dependence on external support (Vignola et al., 2015).

Criterion 5 of the IUCN Global Standard for NbS™ takes these issues into consideration and aims to ensure that the development and management of Nature-based Solutions is inclusive, transparent and does not reinforce power asymmetries (IUCN, 2020b). No Nature-based Solution should contribute to the marginalisation of specific sections of the population, it should become a tool for the co-creation of joint governance mechanisms. In several agricultural production systems worldwide, the power relations between different stakeholders involved in the value chain are often asymmetrical and unfair (Foote, 2021). The indicators of Criterion 5 are:

- **C-5.1.** A defined and fully agreed upon feedback and grievance resolution mechanism is available to all stakeholders before an NbS intervention is initiated.
- **C-5.2.** Participation is based on mutual respect and equality, regardless of gender, age or social status, and upholds the right of Indigenous Peoples to Free, Prior and Informed Consent (FPIC).
- **C-5.3.** Stakeholders who are directly and indirectly affected by NbS have been identified and involved in all processes of the NbS intervention.
- **C-5.4.** Decision-making processes document and respond to the rights and interests of all participating and affected stakeholders.
- **C-5.5.** Where the scale of the NbS extends beyond jurisdictional boundaries, mechanisms are established to enable joint decision-making of the stakeholders in the affected jurisdictions.

If there are indigenous peoples and marginalised groups identified during stakeholder mapping, then the principle of Free Prior and Informed Consent must be upheld. Existing tools developed by international institutions such as the UN CBD Akwé: Kon Voluntary Guidelines (SCBD, 2004), the Mo'otz Kuxtal Voluntary Guidelines (SCBD, 2019) or the CFS's Voluntary Guidelines on the Responsible Governance of Tenure (FAO, 2022a) should be taken into consideration. If the farm transcends national boundaries, then the design of

the NbS should take into consideration based on legislation at both the national and regional levels (e.g. EU acquis). In any case, existing tools such as the IUCN Natural Resource Governance Framework (NRGF) (Springer, Campese & Nakangu, 2021) can also contribute to the better achievement of Criterion 5 when implementing interventions.

The complexity of applying this criterion, especially in the agricultural sector, usually increases with the scale of the planned NbS intervention. If we look at the deployment of an Nature-based Solution on a single privately-owned farm, the percentage of adherence to the IUCN Global Standard for NbS™ could be close to 100%. In the hypothetical case of a single smallholder dairy farmer in the Italian alps:

- The feedback and grievance resolution mechanism required by Criterion 5.1 would be a relatively easy exercise, as well as ensuring the participation of all relevant stakeholders (indicators 5.2 and 5.3). It would be important as mentioned above that all stakeholders from the value chain who interact with the farmer are also mapped and informed.
- The decision-making processes will respond to the right of the interested party, as the farmers would decide for themselves to adopt the NbS, thus adhering to Criterion 5.4.
- Criterion 5.5. on transboundary jurisdiction would be not applicable.

The situation would of course be different in a much more interconnected and complex scenario. The case studies included in the sections below show the potential of an inclusive multi-stakeholder dialogue in a such a complex scenario, and how the governance process embedded in the IUCN Global Standard™ for NbS can be respected.

Lastly, it is important to acknowledge the key role that smallholder farmers, especially women (Hallstein & Iseman, 2021; IFAD, 2023), and indigenous people play in conserving biodiversity. Due to the dominant industrial agricultural system, traditional ways of farming and seed keeping are under increasing pressure (Fernandez-de-Larrinoa, 2022). The combination of agroecological practices with community seedbanks can contribute greatly to halting biodiversity loss and mitigating climate change, preserve traditional knowledge, foster collective actions, and promote socio-economic development. A good example of their potential contribution can be found in the example of Community Seed Banks in China (Reid et al., 2018). At CBD COP 15 in Montréal, leading organisations, including, the United Nations Environment Programme – International Ecosystem Management Partnership (UNEP-IEMP), signed the Montreal Declaration On Small-Scale Women Farmers for Biodiversity Conservation and Sustainable Use (Andes et al., 2022). Amongst the key asks of this declaration there was the request to "*Meaningfully integrate support for agroecological approaches, safeguards to stop land grabs, effective land reform, and appropriate funding for sustainable rural development and smallholder women's organisations across the post-2020 biodiversity targets*". While this may represent only the beginning of a decade long process, it highlights once again the importance of an inclusive governance process in implementing global strategies, a key pillar of the IUCN Global Standard for NbS™.

## 4.6. Criterion 6 and 7: NbS equitably balance trade-offs and are managed adaptively

Criteria 6 and 7 are often analysed together due to the strong interlinkages between trade off- analyses and the need for an adaptive management plan for Nature-based Solutions interventions. For example, the IUCN publication *Aquaculture and Nature-based Solutions* (le Gouvello et al., 2022), jointly addresses these two criteria and Criterion 8 on mainstreaming. In this report, however, the authors decided to separate Criterion 8 due to the increasing recognition of NbS in the international policy scenario.

The three indicators of Criterion 6 are:

- **C-6.1.** The potential costs and benefits of associated trade-offs of the NbS intervention are explicitly acknowledged and inform safeguards and any appropriate corrective actions.
- **C-6.2.** The rights, usage of and access to land and resources, along with the responsibilities of different stakeholders, are acknowledged and respected.
- **C-6.3.** The established safeguards are periodically reviewed to ensure that mutually-agreed trade-off limits are respected and do not destabilise the entire NbS.

The field of agricultural trade-off analysis has been widely investigated by scholars over the years. These analyses initially focused only on agro-economic outcomes but have now expanded to incorporate social and environmental and social outcomes at regional and continental scales (Kanter et al., 2018). Nevertheless, while there is a vast body of literature on different trade-offs between land-use conversion, agri-environmental measures, payment for ecosystem services, few of these studies have included NbS (Miralles-Wilhelm, 2023). More importantly, the application of the trade-off analysis tools in decision-making has been limited (Kanter et al., 2018).

In planning an NbS intervention in an agricultural context, it is key to acknowledge that the nature of the trade-offs depends on location-specific natural, social and cultural conditions that place constraints on the inputs and outputs of an agricultural system (Breure et al., 2024).

Similar to Criterion 5, Indicator 6.2 has been established to ensure that the rights of stakeholders are upheld. Several studies point out the need to co-develop an inclusive trade-off analysis to avoid power asymmetries (Kanter et al., 2018), to increase the legitimacy of the findings (Breure et al., 2024), and to increase its utility to inform practical decision making (Klapwijk et al., 2014). A transparent and inclusive process will also ensure that all views are duly incorporated in the intervention, seen that benefits from NbS are prioritised differently by different groups of people (Miralles-Wilhelm, 2023).

Indicator 6.3 focuses on a continuous review process to ensure that safeguards are respected and provides the link to Criterion 7 on adaptive management. The indicators of the latter are:

- **C-7.1.** An NbS strategy is established and used as a basis for regular monitoring and evaluation of the intervention
- **C-7.2.** A monitoring and evaluation plan is developed and implemented throughout the intervention lifecycle
- **C-7.3.** A framework for iterative learning that enables adaptive management is applied throughout the intervention lifecycle

At the beginning of the section on Criterion 7 in the IUCN Guidance to the NbS Standard (IUCN, 2020b) there is a clear link between adaptive management and indicator 2.3 (The design of the NbS incorporates risk identification and risk management beyond

the intervention site) and 3.3 (Monitoring includes periodic assessments of unintended adverse consequences on nature arising from the NbS). Indeed, the adaptive management plan needs to consider that trade-offs occurring within agricultural systems, span across time and spatial scales, and between actors (Klapwijk et al., 2014). In an agro-ecosystem, correctly understanding these dynamics is central to achieving a sustainable and food secure future (Klapwijk et al., 2014).

Indicators 7.1 and 7.2 provide a continuous feedback loop enabling users to learn and adapt the NbS intervention (IUCN, 2020b). This is critical in dynamic agricultural landscapes. For example, in an analysis on agro-environmental trade-offs in the Argentinean Chaco, researchers have found that land-use strategies found optimal at one point in time could be detrimental in case of landscape change, and that adaptive strategies are needed to analyse and manage trade-offs between agriculture and biodiversity (Macchi et al., 2020).

Lastly, it is worth re-emphasising the need of an iterative learning framework in monitoring the NbS intervention (Indicator 7.3). The conceptual model developed by Kanter et al. (2018) provides an interesting example of this adaptive management (Figure 3). The first part of the diagram focuses on a stakeholder-informed decision-making process, in this case about sustainable agricultural intensification. The second section of the diagram depicts a mechanism through which outputs of this process are translated into scenarios, identifying appropriate indicators, data and models to carry out the trade-off analysis (Kanter et al., 2018). To note the curved arrow which indicates the regularity and iterative nature of this process.

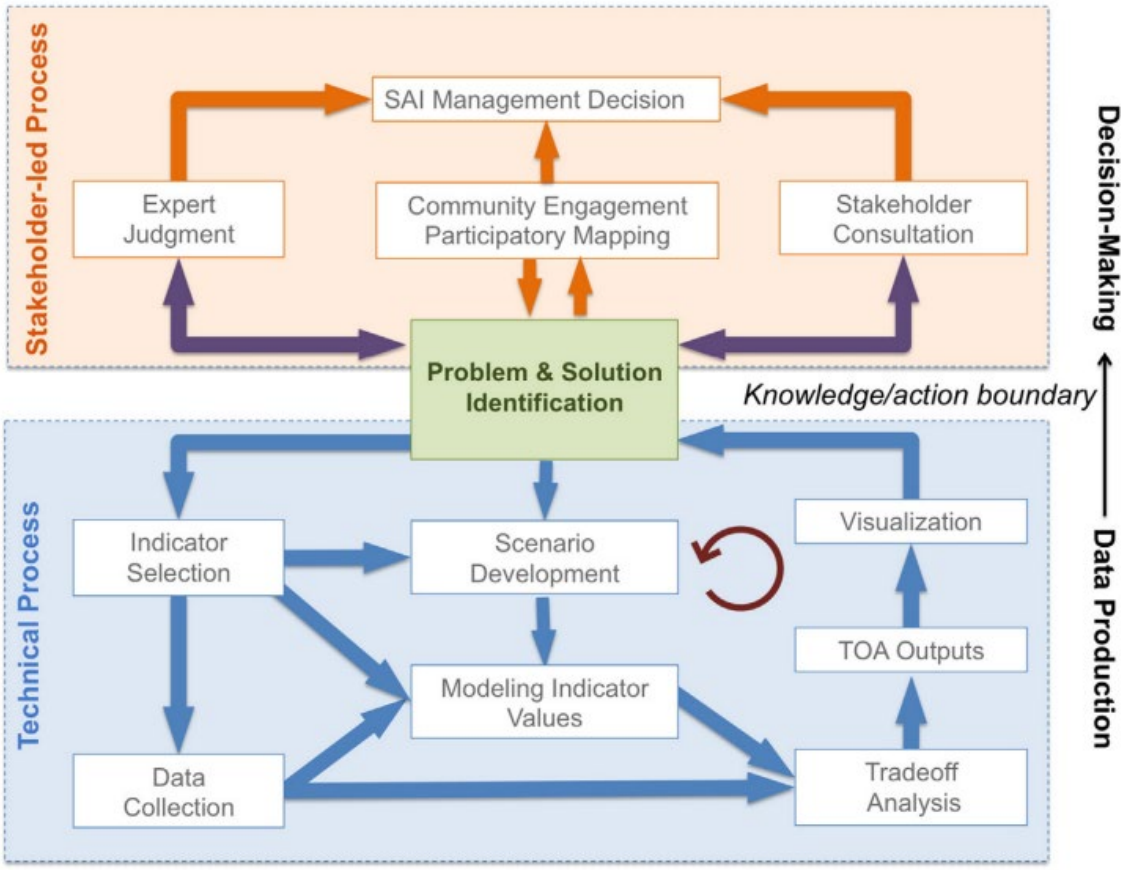


**Fig. 3.** Conceptual framework for stakeholder engagement and trade-off analysis (TOA) developed by Kanter et al. (2018)

## 4.7. Criterion 8: NbS are sustainable and mainstreamed within an appropriate jurisdictional context

In the international science-policy debate, Nature-based Solutions have gained prominence due to their ability to break the silos that have historically inhibited the efforts of the environmental movement to engage in cross-sectoral integrated solutions. In 2019, the landmark IPBES Global Assessment endorsed NbS, recognising their potential contribution to addressing both climate change and biodiversity loss, and deemed land-use actions "indispensable" in this context (IPBES, 2019; Seddon et al., 2020b).

To ensure that their transformative potential is harnessed and continues over time, Criterion 8 of the IUCN Global Standard for NbS™ focuses on mainstreaming in the jurisdictional context. The indicators for this criterion are:

- **C-8.1**. The NbS design, implementation and lessons learnt are shared to trigger transformative change
- **C-8.2** The NbS informs and enhances facilitating policy and regulation frameworks to support its uptake and mainstreaming
- **C-8.3**. Where relevant, the NbS contributes to national and global targets for human well-being, climate change, biodiversity and human rights, including the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP)

On the first indicator, a growing body of literature, projects, and interventions on the ground is testifying to how NbS have the potential to conserve biodiversity, reduce emissions, ensure socio-economic stability for farmers and improve the overall health of our planet (UNCCD, 2017b). Disseminating scientific results, project outcomes and lessons learned from NbS implementation is paramount. For that reason, there are already several platforms that have built very useful databases, amongst them are NetworkNature and Panorama Solutions.

Nature-based Solutions are being discussed and referred to increasingly in the international policy context. Across the three UN Rio Conventions[5], NbS feature predominantly in the Framework Convention on Climate Change (UNFCCC). However, thanks to the work of IUCN and other stakeholders, NbS have recently also gained an important spotlight within the Convention on Biological Diversity (CBD) and in the Convention to Combat Desertification (UNCCD). For a deeper analysis of the international policy scenario in which NbS are framed, in line with indicators 8.2 and 8.3., the following sections look at NbS across the issues of climate, desertification, and biodiversity policy. To conclude, the chapter includes a brief overview of the European Union policy on NbS, seen the ever-growing importance of the topic within the EU.

### Climate – The United Nations Framework Convention on Climate Change

The international climate action community has acknowledged the value of Nature-based Solutions on several occasions. The two most cited cases are the inclusion of NbS as one of the actions agreed at the 2019 UN Climate Action Summit (Climate Action Summit, 2019; IISD, 2019) as well as their mention in the Climate Change and Land Report of the Intergovernmental Panel on Climate Change (IPCC, 2019; Seddon et al., 2020a). In both cases, Nature-based Solutions are mentioned within the wider context of the adaptation of food systems to climate change. Furthermore, in 2021, an

5 In response to global environmental challenges, governments founded three "Rio Conventions" at the 1992 Earth Summit in Rio de Janeiro, Brazil. These are the United Nations Framework Convention on Climate Change (UNFCCC), the Convention on Biological Diversity (CBD), and the United Nations Convention to Combat Desertification (UNCCD).

IPCC-IPBES joint workshop on biodiversity and climate change, which used the IUCN definition as its basis for the Nature-based Solutions discussion, highlighted the role that NbS can play in shaping integrated policies and initiatives (Melanidis & Hagerman, 2022; Pörtner et al., 2021).

Under the COP21 Paris Agreement, Parties agreed to hold global warming well below the 1,5/2°C mark, recognised in several articles (Art. 4, Art. 5, Art. 6, Art. 7, Art. 8, and in the preamble) the importance of healthy ecosystems and conserving biodiversity in the fight against climate change (Seddon et al., 2019; UNFCCC, 2015). Moreover, of the 122 Nationally Determined Contributions (NDC) submitted in 2021 in compliance with the Paris Agreement, over 80% included the protection and restoration of ecosystems and 41% mention Nature-based Solutions (ENACT Partnership, n.d.). In addition, some studies show that Nature-based agricultural practices were mentioned as adaptation measures in 40 NDCs (Seddon et al., 2020b). This positive trend of increasing recognition of NbS is also acknowledged by a WWF study that saw the number of NDCs explicitly mentioning NbS increase from 43 to 50 out of 55 Parties analysed in May 2021 (Bakhtary, Elbrecht & Haupt, 2021a). In 2021, another WWF study made several links between sustainable agriculture and NbS and concluded that enhanced NDCs should identify the co-benefits of NbS for climate change, including desertification, food security and livelihoods of local communities (Bakhtary, Elbrecht & Haupt, 2021b).

However, researchers have pointed out that despite these positive signs, the potential of NbS is not fully unlocked in the Parties' NDCs, especially in those of the Global North, and their implementation lacks clear goals and targets in many instances (Seddon et al., 2019; Seddon et al., 2020b; Schulte et al., 2020).

During COP27 in Sharm el-Sheikh, IUCN, the Egyptian Presidency, and the German Government launched the ENACT Initiative. ENACT aims to coordinate global efforts to address climate change, land, and ecosystem degradation, and biodiversity loss through NbS (ENACT Partnership, n.d.). One of the goals of the initiative is to secure up to 2.4 billion ha of healthy natural ecosystems through protection of 45 million ha, sustainable management of 2 billion ha, and restoration of 350 million ha (ENACT Partnership, n.d.). Furthermore, at COP27, NbS were included for the first time in a COP cover decision, as they featured in the Forest section (NBSI, 2022). Under the decision, the Conference of the Parties:

> *"...Encourages Parties to consider, as appropriate, nature-based solutions or ecosystem-based approaches, taking into consideration United Nations Environment Assembly resolution 5/5,31 for their mitigation and adaptation action while ensuring relevant social and environmental safeguards"* (UNFCCC, 2022b).

Before COP28, the ENACT Partnership worked alongside the NDC Partnership, the United Arab Emirates as the UNFCCC COP28 Presidency, and the People's Republic of China as the UN CBD COP15 Presidency to develop the COP28 Joint Statement on Climate, Nature and People (IUCN, 2024). This statement promotes the scaling of finance for nature and climate including through NbS (UNFCCC, 2023).

Lastly at COP28 in Dubai, the decisions on the Global Goal on Adaptation (paragraph 9) and the Global Stocktake (paragraph 55) explicitly mention NbS. In the latter, Nature-based Solutions are highlighted in the same context as sustainable agriculture, notably: "*55. Encourages the implementation of integrated, multi-sectoral solutions, such as land-use management, sustainable agriculture, resilient food systems, nature-based solutions and ecosystem-based approaches, and protecting, conserving and*

*restoring nature and ecosystems, including forests, mountains and other terrestrial and marine and coastal ecosystems, which may offer economic, social and environmental benefits such as improved resilience and well-being, and that adaptation can contribute to mitigating impacts and losses, as part of a country-driven gender-responsive and participatory approach, building on the best available science as well as Indigenous Peoples' knowledge and local knowledge systems;"* (UNFCCC, 2024).

### Desertification – The United Nations Convention to Combat Desertification

The expansion of crop and grazing lands into native vegetation, unsustainable agricultural and forestry practices, global consumption patterns and climate change are all considered drivers of land degradation (Sutton et al., 2016; UNCCD, 2017b).

The promotion of Nature-based Solutions within the work of the United Nations Convention to Combat Desertification (UNCCD) is one of the focus areas of the long-standing collaboration between IUCN and the UNCCD, institutionalised by a Memorandum of Understanding signed in 2012. IUCN is an institutional observer of the Science Policy Interface of the UNCCD and a member of the Inter Agency Task Force of the UN Decade on Deserts and the Fight against Desertification (UNDDD) (IUCN, n.d.-c). The primary goal of the IUCN-UNCCD Joint Work Plan 2015–2020 was to "Support progress towards policies and programmes that deliver Land Degradation Neutrality through the application of Nature-based Solutions (at national and sub national levels)" (IUCN, 2015). In 2015, IUCN also published a technical brief to further contribute to the inclusion of NbS in the work of the UNCCD and to affirm their importance in achieving Land Degradation Neutrality (LDN). This technical brief was titled: *Land Degradation Neutrality: implications and opportunities for conservation – Nature Based Solutions to Desertification, Land Degradation and Drought* (IUCN, 2015). The UNCCD itself, in collaboration with IUCN, also promoted the concept of NbS in other fora, including during UNFCCC COP23 in 2017 when it discussed "Nature-based solutions for water and adaptation to climate change" (UNCCD, 2017a).

At the COP in Abidjan (UNCCD COP15), Nature-based Solutions were included in the text of Decision 8, under which the Conference of the Parties:

> "*Invites Parties to explore complementarities within relevant Multilateral Environmental Agreements, within their respective mandates and goals, in the achievement of the objectives of the United Nations Convention to Combat Desertification at the national level, including, as appropriate, in the implementation of sustainable land management, ecosystem-based approaches or nature-based solution*" (UNCCD, 2022a).

### Biodiversity – The United Nations Convention on Biological Diversity

Under the Convention on Biological Diversity (CBD), several related concepts and approaches linked to Nature-based Solutions have played a central role since it was drafted in 1992. For example, the ecosystem approach, which has been described as the primary framework for action under the CBD, has a definition and operational guidance that were endorsed by all parties in 2000 during the ENACT Partnership (Decision V/6) (CBD, 2000[6]).

6 Other decisions of the CBD can be linked to NbS, in particular decisions VI/22, X/2, X/33, XII/19, XIII/20, XIII/5, and XIV/5 (UNFCCC, 2021), as well as Target 15 of the CBD Strategic Plan for Biodiversity 2011-2020 (CBD, 2010).

A pivotal moment for NbS in international environmental policy was the explicit inclusion of the term in the Kunming-Montreal Global Biodiversity Framework (CBD, 2022). The Framework includes NbS in two of its targets:

- ***"TARGET 8**: Minimise the impact of climate change and ocean acidification on biodiversity and increase its resilience through mitigation, adaptation, and disaster risk reduction actions, **including through nature-based solution** and/or ecosystem-based approaches, while minimising negative and fostering positive impacts of climate action on biodiversity."*

- ***"TARGET 11**: Restore, maintain and enhance nature's contributions to people, including ecosystem functions and services, such as regulation of air, water, and climate, soil health, pollination and reduction of disease risk, as well as protection from natural hazards and disasters, **through nature-based solutions and/or ecosystem-based approaches for the benefit of all people and nature**."*

Two other targets of this framework can be considered especially relevant to the present report, those addressing pollution (including from agriculture), and agriculture.

Target 7 is relevant as it places a considerable focus on pollution linked to agricultural activities, a major threat outlined in Chapter 2.1 of the present report. It reads:

- "*Reduce pollution risks and the negative impact of pollution from all sources by 2030, to levels that are not harmful to biodiversity and ecosystem functions and services, considering cumulative effects, including: (**a) by reducing excess nutrients lost to the environment by at least half, including through more efficient nutrient cycling and use; (b) by reducing the overall risk from pesticides and highly hazardous chemicals by at least half, including through integrated pest management, based on science, taking into account food security and livelihoods;** and (c) by preventing, reducing, and working towards eliminating plastic pollution."*

Target 10 recognises the role that healthy agroecosystems play in conserving and sustainably using biodiversity:

- "*Ensure that areas under agriculture, aquaculture, fisheries and forestry are managed sustainably, in particular through the sustainable use of biodiversity, **including through a substantial increase of the application of biodiversity friendly practices, such as sustainable intensification, agroecological and other innovative approaches**, contributing to the resilience and long-term efficiency and productivity of these production systems, and to food security, conserving and restoring biodiversity and maintaining nature's contributions to people, including ecosystem functions and services."*

In addition, Target 18 calls for a reduction of at least USD 500 billion per year in harmful subsidies by 2030. The section on Criterion 4 outlined why there is an urgent need for a restructuring of the current state agricultural subsidies, in view of their detrimental or sub-optimal impact on the environment. This key component of the framework reinforces the call for fairer and greener support mechanisms for all, including farmers.

It is clear that in implementing the framework, IUCN's knowledge, standards and tools will be fundamental. An example is given by the recent paper by Nicholson et al. (2024) which shows how the IUCN Red List of Ecosystems can have an important role in 16 of 23 targets.

### Nature-based Solutions in EU policy

The European Union has been a frontrunner in the promotion of NbS, as proved by the definition in 2015. For that reason, the authors deemed important to provide a brief overview of NbS in EU policy.

Indirect references to NbS have long been included in key EU policies through related terms, such as EbA. However, quantifiable targets and explicit references were rare (Davis et al., 2018). This changed in 2019 with the approval of the European Green Deal, under which greater emphasis was placed on the value of Nature-based Solutions. The table below, adapted from the Network Nature knowledge brief "Taking nature-based solutions up the policy ladder: from research to policy action" (NetworkNature, 2022), gives a snapshot of the inclusion of NbS in key EU policies:

| EU policies, strategies and approaches | Level of NbS support | Type of integration |
|---|---|---|
| European Green Deal | Strong | Explicit |
| Biodiversity Strategy for 2030 | Strong | Explicit |
| Bioeconomy Strategy | Medium | Explicit |
| Forest Strategy | Medium | Implicit |
| Green Infrastructure Strategy | Strong | Explicit |
| LULUCF Regulation | Medium | Implicit |
| Action Plan on the Sendai Framework | Strong | Explicit |
| Climate Adaptation Strategy[7] | Strong | Explicit |
| Common Agricultural Policy | Medium | Implicit |
| Farm to Fork Strategy | Medium | Explicit |
| Water Framework Directive | Medium | Implicit |
| Floods Directive | Strong | Implicit |
| Urban Agenda | Medium | Explicit |
| Circular Economy Action Plan | Medium | Explicit |
| EU blue economy agenda | Strong | Explicit |
| Zero Pollution Action Plan | Medium | Explicit |

With regards to EU agricultural policy, some provisions in the CAP (more diverse use of crops, agro-forestry, and minimum tillage) can be considered supportive of NbS, even if they are not explicitly referred to as such. It is foreseen that the future 2027 Common Agricultural Policy would further incorporate NbS in the measures which can be used to work towards a more sustainable food system (NetworkNature, 2022).

Moreover, the body of knowledge on NbS funded by the EU is expanding through the efforts of several Horizon, LIFE, and Interreg projects, in addition to the work of the Joint Research Centre, the relevant Directorates General, and of specialised agencies of the EU. Several EU publications on the topic have highlighted the benefits that Nature-based Solutions can bring to society. For example, in April 2020, the European Commission released the report *Biodiversity*

7 The IUCN Global Standard for NbS™ is explicitly mentioned in the 2021 EU Strategy on Adaptation to Climate Change in section *2.2.4. Promoting nature-based solutions for adaptation.*

*and Nature-based Solutions – Analysis of EU-funded projects* (EC, 2020). In this collection of data, the Commission's Directorate General for Research and Innovation looked at how NbS can support the objectives of the EU Biodiversity Strategy for 2030 and of the Global Biodiversity Framework, while delivering a range of ecosystem services. Within the study, and relevant for this report, the EC pointed out how NbS are also critical for sustainable agriculture production systems:

> "Nature-based farming practices are available that provide win-win scenarios, i.e. simultaneously addressing climate change mitigation and adaptation, biodiversity protection, soil and water management objectives. In the majority of cases, these also make long-term financial sense for farmers (improved resource efficiency and resilience to climate impacts), but there are short-term costs and risks that need to be overcome. Promoting NbS in rural areas requires a three-fold approach:
>
> - *broad application of agro-ecological agronomic practices - examples include cover/catch crops and reducing bare fallow, retaining crop residues on the field, extending perennial phase of crop rotations, using perennial crops (also for alternative protein production), permaculture, using adapted crops, reduced tillage and zero tillage;*
>
> - *promotion of agroforestry, woody landscape features or food forests, which can be part of a green infrastructure network and qualify as NbS given their multifunctionality; and*
>
> - *enhancing agrobiodiversity for resilient farming systems, healthier nutrition and human well-being - this would encompass both nutritionally-rich biodiversity (cultivated and wild edible species) and 'functional agrobiodiversity'."*

In a subsequent publication on the vital role of NbS in a nature positive economy, an independent report from the European Commission reinforced the linkages between agricultural systems and Nature-based Solutions by quoting Oberč and Arroyo Schnell (2020): "*Nature-based Solutions can provide a pathway to transition towards sustainable agriculture as NbS can shift agricultural land [management, ndr] from being a driver of negative environmental impact to being a solution (DG-RTD, 2022)*".

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# 5. Aligning sustainable agriculture with the IUCN Global Standard for NbS™

The previous chapters looked at the current challenges in agriculture, the theoretical background of Nature-based Solutions, and the international policy context. This review provided the foundation for an analysis of the alignment of sustainable agricultural approaches with the criteria of the IUCN Global Standard for NbS™.

The chapter builds on the findings of Oberč & Arroyo Schnell (2020), discussed in Chapter 2 of this report, thus each of the fourteen approaches identified in their publication will be analysed here. The fourteen approaches are:

| | |
|---|---|
| Agroecology | Carbon farming |
| Nature-inclusive agriculture | Climate-smart agriculture |
| Permaculture | High nature value farming |
| Biodynamic agriculture | Low external input agriculture |
| Organic farming | Circular agriculture |
| Conservation agriculture | Ecological intensification |
| Regenerative agriculture | Sustainable intensification |

**By its nature, this is a theoretical exercise, as the implementation of these practices on the ground may differ from the principles upon which they are built. Each intervention is context specific, and whether they are an NbS or not should be assessed on a case-by-case. The present report only underscores synergies between the approaches and the IUCN Global Standard**.

In any case, it is important to keep in mind that the 14 approaches mentioned above, and the supporting practices listed in Chapter 2, are all valuable alternatives to the current unsustainable conventional agricultural farming (Oberč & Arroyo Schnell, 2020). The extent to which they align with the IUCN Global Standard for Nature-based Solutions™ should not be taken as reasons against their uptake and/or promotion as greener and fairer options for our food system.

This chapter follows a similar structure for each approach:

- A definition, to ensure that readers who are not familiar with the concepts can gain a basic understanding.
- An analysis of the alignment of each sustainable agricultural approach with IUCN Global Standard for NbS™.
- A summary of possible complementary measures that better align each approach to the IUCN Global Standard for NbS™. These final recommendations are not intended to change the theoretical basis of any of the approaches discussed, nor is this an evaluation of them. It is simply

a consideration based on their alignment with the concept of Nature-based Solutions.

This assessment also responds to the increasing demand for clarity in applying NbS in agriculture. The FAO states that "the extent to which the IUCN Global Standard for NbS™ can be applied for NbS in agriculture is still to be assessed" (Arnés García & Santivañez, 2021). Meanwhile a joint ILO/UNEP/IUCN publication calls for clarity in that "the combinations of NbS and non-NbS practices that could constitute NbS agriculture approaches is not clear" (ILO, UNEP & IUCN, 2022). The following section aims to shed some light on this issue.

## 5.1. Agroecology

*Definition*: "*As a science, agroecology gives priority to action research, holistic and participatory approaches, and transdisciplinarity that is inclusive of different knowledge systems. As a practice, it is based on sustainable use of local renewable resources, local farmers' knowledge and priorities, wise use of biodiversity to provide ecosystem services and resilience, and solutions that provide multiple benefits (environmental, economic, social) from local to global. As a movement, it defends smallholders and family farming, farmers and rural communities, food sovereignty, local and short food supply chains, diversity of indigenous seeds and breeds, healthy and quality food*" (Agroecology Europe, n.d.).

*NbS alignment*: Since its early conceptualisation, the agroecological approach focuses on the three pillars of sustainability. As seen above, this approach is based, inter alia, on "***solutions that provide multiple benefits (environmental, economic, social)*** *from local to global*". This framing is useful for an assessment of the alignment of the agroecology with Criterion 1 (addressing societal challenges). To fully achieve indicator 1.3 (*Human well-being outcomes arising from the NbS are identified, benchmarked and periodically assessed*), it is key to ensure that the application of agroecological farming practices is coupled with specific, measurable, attainable, realistic and timebound (SMART) targets. Such clarity and accountability mechanisms will also help to meet Criterion 7 (adaptive management).

When looking at scale (Criterion 2), one of the three key principles of agroecology defined by IIED is planning, which predicates that the farming system acts in harmony with the landscape and its ecological limits (Silici, 2014). Furthermore, the whole-farm approach and the heterogeneity of practices included in this agricultural method can be applied to all farms and production types, hence it is scalable (Oberč & Arroyo Schnell 2020). Agroecology is usually defined at different geographical levels from plot to landscape levels (Malézieux, 2012), and it draws on synergies with social movements and economic actors. On the temporal dimension of scale in Criterion 2 (design at scale), there are some roadmaps that envision a full transition to agroecology in specific contexts, such as the Ten Years for Agroecology (TYFA) project, which shows the potential benefits of an agroecology transition (Aubert, 2021; Oberč & Arroyo Schnell 2020).

The conservation and sustainable use of biodiversity is at the core of agroecology. It aims to minimise the use of inputs (fertilizers, pesticides and other agrochemicals), while striving to enhance biological interactions. Agroecology focuses on conserving and diversifying species and genetic diversity at the field and landscape level of the

agroecosystem. In the systematic review of Wezel et al. (2020), it was found that four of the thirteen principles of agroecology can be linked directly to biodiversity conservation (Criterion 3), namely:

- (3) *Soil health:* Secure and enhance soil health and functioning for improved plant growth, particularly by managing organic matter and enhancing soil biological activity.
- (4) *Animal health:* Ensure animal health and welfare.
- (5) *Biodiversity:* Maintain and enhance diversity of species, functional diversity and genetic resources and thereby maintain overall agroecosystem biodiversity in time and space at field, farm and landscape scales.
- (6) *Synergy:* Enhance positive ecological interaction, synergy, integration and complementarity amongst the elements of agroecosystems (animals, crops, trees, soil and water).

Furthermore, most practices that fall under the wider umbrella of agroecology have been proven to be beneficial for biodiversity. From cover crops and conservation tillage to agroforestry, agroecology takes a holistic approach to land and resource management, taking into consideration nature's biological cycles therefore harnessing the potential of nature.

On the economic aspect (Criterion 4), the interlinkages between the IUCN Global Standard for NbS™ and agroecology are less prominent than with other criteria. The economic viability of agroecology is highly dependent on the specific context, on consumer preferences, the state of the market, and existing agricultural policies. As noted by Oberč and Arroyo Schnell (2020), the broad interpretation of agroecology makes it challenging to achieve economies at scale. More specifically, it complicates achieving indicator 4.4 (*NbS design considers a portfolio of resourcing options such as market-based, public sector, voluntary commitments and actions to support regulatory compliance*).

Nevertheless, several of the 13 agroecological principles mentioned above are linked to improving the economic feasibility of NbS uptake. A reduction in inputs and fertilisers, coupled with the improved efficiency in energy resources would not only reduce costs in the short term, but also contribute to healthier agrobiodiversity in the long term. This in turn would lead to more resilient and profitable farms and landscapes. Furthermore, the shorter supply chain advocated by agroecology could also suggest an increase in profit for the farmers (HLPE, 2019). The agroecological principle of *economic diversification* also ensures that the diversification of on-farm incomes would allow small-scale farmers to have greater financial independence and value addition opportunities while meeting consumer demand (Wezel et al., 2020). This diversification would also allow the farmers to be more economically resilient to the increasing number of natural disasters and shocks. Overall, the alignment with Criterion 4 can be deemed adequate.

The economic model embedded in the concept of agroecology would drastically reduce the energy inputs and the amount of food waste (one third of global food production). As highlighted in the recent IUCN publication "Towards a circular economy that begins and ends in nature", a reduction in food waste, coupled with a shift to healthier diets, could help to achieve important environmental targets, e.g. under the EU Biodiversity Strategy to 2030 (Oberč et all., 2022). Complementing this, the study by Röös et al. (2022) confirmed that if the large-scale uptake of agroecology was coupled with drastic dietary change and waste reductions, most EU environmental and climate targets would be met (Röös et al., 2022). In addition, agroecology advocates for a transition towards a solidarity economy, one

that prioritizes local markets and supports local economic development (FAO, 2018a), in line with the objectives of Criterion 5 (inclusive governance).

The social dimension of agroecology derives from its bottom-up approach and the co-creation of knowledge through participatory processes (FAO, 2018a). According to the FAO, agroecology places significant emphasis on human rights and social values, such as dignity, equity, inclusion and justice (FAO, 2018a). Furthermore, agroecology promotes local smallholders' knowledge and indigenous food systems. Looking back at the consolidated 13 principles for agroecology, five of them are key for Criterion 5:

- *8. Co-creation of knowledge*: Enhance co-creation and horizontal sharing of knowledge including local and scientific innovation, especially through farmer-to-farmer exchange.
- *9. Social values and diets*: Build food systems based on the culture, identity, tradition, social and gender equity of local communities that provide healthy, diversified, seasonally and culturally appropriate diets
- *10. Fairness*: Support dignified and robust livelihoods for all actors engaged in food systems, especially small-scale food producers, based on fair trade, fair employment and fair treatment of intellectual property rights.
- *12. Land and natural resource governance*: Strengthen institutional arrangements, including the recognition and support of family farmers, smallholders and peasant food producers as sustainable managers of natural and genetic resources.
- *13. Participation:* Encourage social organisation and greater participation in decision-making by food producers and consumers to support decentralised governance and local adaptive management of agricultural and food systems. This is in line with the concept of Community-Supported Agriculture, which intrinsically strives to modify power relations within the food system.

Looking at Criterion 8 (mainstreaming NbS in policy), agroecology is well placed to be integrated in key international, regional and national frameworks. The FAO defined agroecology as a key response to guide the transformation of food systems and to achieve 15 of the 17 Sustainable Development Goals included in the UN 2030 Agenda (FAO, n.d.-a). Moreover, the IUCN resolution at the basis of this report can be considered a key policy input in the global environmental discussion. Resolution 7.007 (IUCN's Members' Assembly, 2020a) on Developing agroecological practices as Nature-based Solutions recommends that:

> "*states, communities, indigenous peoples, local stakeholders, and industry develop, promote and incentivise the adoption of agroecological practices as NbS as appropriate and integrate them into their national policies, as part of sustainable food systems. Measures to promote agroecological approaches should be implemented by states consistently with their national and international obligations*".

Lastly, the newly adopted Kunming-Montreal Global Biodiversity Framework also recognises the role of agroecology to achieve the 2050 vision of Living in Harmony with Nature. In fact, Target 10 states:

> "*Ensure that areas under agriculture, aquaculture, fisheries and forestry are managed sustainably, in particular through the sustainable use of biodiversity, including through a substantial increase of the application of biodiversity friendly practices, such as sustainable intensification,* ***agroecological and other innovative approaches*** *contributing to the*

*resilience and long-term efficiency and productivity of these production systems and to food security, conserving and restoring biodiversity and maintaining nature's contributions to people, including ecosystem functions and services*" (CBD, 2022).

**Summary**: The core principles of agroecology, the focus on the three pillars of sustainability, and the emphasis on transparent governance, make it apparent that agroecology is well aligned with the concept of NbS. This said, much like Nature-based Solutions, agroecology is context specific. For that reason, its exact alignment to the IUCN Global Standard for NbS™ will largely depend on the particular implementation of a particular Nature-based Solution in a specific setting. Thus, the reality on the ground will affect compliance with the criteria of the IUCN Global Standard and the overall assessment.

## 5.2. Nature-inclusive agriculture

*Definition*: "*An economically viable agriculture system that optimally manages natural resources and provides a basis for sustainable business operations, including caring for ecological functions and biodiversity on or around the business i.e. farm*" (van Doorn et al., 2016).

*NbS alignment*: Regarding Criterion 1 (societal challenges), the approach strives to "*optimise ecological processes for food production, integrating food production and natural capital in such a way that agriculture and nature can reinforce one another*" (Oberč & Arroyo Schnell, 2020). This approach therefore recognises the need for a transformative change in agriculture, nature-inclusive principles while addressing the societal challenges of environmental degradation and food security. The nature-inclusive model was developed by the Dutch Ministry of Economic Affairs in 2014 (Runhaar, 2016). While this might be a barrier for the translation of the approach to different geographical contexts, it does not necessarily preclude the implementation of nature-inclusive agriculture at scale to every type of production (Criterion 2). Furthermore, this approach is derived directly from agroecology; thus, it takes a whole farm approach and calls for the co-creation of knowledge from actors across different sectors (Indicator 2.2.).

Nature-inclusive agriculture aims at maximising the contribution of nature to agriculture, while minimising the negative impacts of agriculture on nature. To do so, the focus is placed on functional agrobiodiversity. The reduction in inputs, in emissions, and the attention placed on soil health help to create positive ecosystem conditions for different species at all levels. Fostering a healthier relationship between agriculture and nature is also visible in the landscape approach adopted by nature-inclusive agriculture. The (re)introduction of herb and flower edges, messy corners, and other green infrastructure supports the understanding of a wider landscape, within which farmers collaborate to conserve biodiversity and, in turn, achieve more resilient agroecosystems.

Regarding the economic viability of the approach (Criterion 4), nature-inclusive agriculture was developed to provide the basis for sustainable business operations. The goal is to create a mass market for sustainably produced food and ensure greater uptake of its practices. This market-oriented approach is well suited to fulfil indicator 4.4. on "*a portfolio of resourcing options such as market-based, public sector,*

*voluntary commitments and actions to support regulatory compliance*" (Oberč & Arroyo Schnell, 2020).

In support of Criterion 5 (inclusive governance), the principle of "knowledge co-creation" is a key feature of this approach. Runhaar states that "*the concept of nature-inclusive agriculture is still rudimentary (2016) and therefore there is potential for farmers, citizens, scientists, policymakers, agri-food companies and other stakeholders to jointly give it meaning*" (Runhaar, 2016). It is hoped, among academics, that this transparent process if implemented correctly, could also support the achievement of Criterion 5 (transparent governance). However, though it is derived from agroecology, the approach focuses less on the social dimensions of agriculture than agroecology does.

When it comes to linking nature-inclusive agriculture to transformative change and policy (Criterion 8), there are some hurdles linked to the relative novelty of the concept. Oberč and Arroyo Schnell (2020) described the main challenge as follows: "Integration into policy and the value chain will, require quantifiable indicators and measurable impacts, whereas at the moment, as is the case for a number of approaches to sustainable agriculture, evidence linked to the approach is primarily qualitative". Hence, to ensure a greater uptake of the approach, as well as a better alignment with Criterion 8, mainstreaming in jurisdictional and policy contexts component could be strengthened.

**Summary**: The IUCN Global Standard for NbS™ principles are well aligned with nature-inclusive agriculture, however there are some areas which inhibit their full integration. The approach places nature at the heart of a healthy and sustainable food system and seeks to ensure the equitable involvement of farmers in the process. It is still a relatively recent development with elements that are context specific to the particular landscape and/or the farm. As a result, there is still work ahead in adapting this concept to different realities around the world. Nonetheless, its potential to mitigate the ongoing environmental crisis while addressing societal challenges has promise. A stronger focus on the social component, on human rights, and on inclusive governance would further align the approach to the concept of NbS. In addition, for it to be considered an NbS, nature-inclusive farms would need to develop monitoring and reporting schemes, coupled with SMART targets and measurable indicators.

## 5.3. Permaculture

*Definition*: "*Permaculture is a holistic approach to agriculture that provides for human needs—high-quality food, fibre, fuel, medicine and building materials—while enhancing the ecosystems and communities from which these derive; it offers a set of ethics and principles and a means of integrating social and ecological processes in a way that is grounded in the local context*" (LPU, 2018).

*NbS Alignment*: Permaculture focuses on the interactions between nature and local agricultural communities. It advocates for localised food systems and promotes *slow solutions*. It originated in the 1970s, however, the first principles of its theoretical conceptualisation were enunciated in 2002.

In a highly globalised world, where in most cases consumers have been detached from producers, permaculture aims to rekindle the human-nature connection in agriculture. Regarding Criterion 1 (societal challenges), this approach highlights the need for a shorter food chain and reiterates

the importance of community engagement. Many of the societal challenges that NbS aim to address can be solved by virtue of the strong social component of this approach, albeit at a smaller and more local level. Indeed, "*living more in tune with local surpluses and limits*" (IUCN, 2020b) is one of its core principles.

In relation to Criterion 2 (design at scale), permaculture takes a holistic approach to farm management and aims to maximise the use of the different produced goods. Nevertheless, the approach teaches self-sufficiency, thus limiting the scope for interaction and synergies between stakeholders and other sectors. The same narrow focus could make it challenging to achieve Criterion 4 (NbS are economically viable) at scale and in turn Criterion 8 (NbS are mainstreamed) when the amount of knowledge needed to implement certain practices is taken into account, such as Hügelkultur. However, just as for several of the approaches analysed in this publication, these concepts are not immune to change and future iterations might improve their alignment with the concept of NbS. In the case of permaculture some limited networks have been working to export the approach to larger scale, such as in the case of the Transition network (Transition Network, n.d.).

Agrobiodiversity (Criterion 3) is well incorporated into this approach. Permaculture values the ecosystem services that arise from marginal and non-productive areas on the farm. By dividing the farm into different zones, permaculture includes semi-wild areas and "wilderness" areas in its design. In addition, the integration of agroforestry, the attention to animal welfare, and the diversity of ecosystems promoted attest to the environmental focus of permaculture.

As for the alignment of permaculture with Criterion 7 (NbS adaptive management), three principles listed by Holmgren best show permaculture's *progressive management* style:

- Observe and interact: By taking time to engage with nature, design solutions that suit a particular situation.
- Creatively use and respond to change: have a positive impact on inevitable change by carefully observing, and then intervening at the right time.
- Apply self-regulation and accept feedback: discourage inappropriate activity to ensure that systems can continue to function well.

These principles of observation and adaptive management can also greatly contribute to the achievement of the biodiversity-related indicators 3.2. and 3.3 of the IUCN Global Standard for NbS™, respectively on periodically assessing the intervention and on monitoring biodiversity.

Lastly, because farmers are primary producers and users, the approach could achieve the necessary IUCN Global Standard for NbS™ requirements concerning the transparent governance process (Criterion 5). Being a largely localised approach, Indicator 5.5[8] on transnational coordination mechanisms might not be relevant or challenging to achieve.

**Summary**: Permaculture is well-aligned with the environmental and social aspects of the IUCN Global Standard for NbS™, as well as with its continuous process of monitoring and adaptation. However, it is better suited to a more limited context, restricting its potential for the achievement of Criteria 2 and 4 and, in turn, making this approach less scalable at the market level.

8 5.5. Where the scale of the NbS extends beyond jurisdictional boundaries, mechanisms are established to enable joint decision making of the stakeholders in the affected jurisdictions (IUCN, 2020a).

## 5.4. Biodynamic agriculture

*Definition*: "*Biodynamic agriculture is an ecological farming system that views the farm as a self-contained and self-sustaining organism*" (Biodynamic Federation Demeter International, 2012).

*NbS Alignment*: Biodynamic agriculture became an established concept at the beginning of the 21st century. It was developed in response to the rapid declines in soil fertility and to damaged ecosystems health caused by increasing use of in pesticides and fertilisers in agriculture, while placing the livelihood and health of farmers at risk. In line with Criterion 1 (NbS effectively address societal challenges), biodynamic agriculture acknowledges the issues surrounding unsustainable farming and tries to provide an ecologically sustainable and economically viable alternative through its Demeter certification[9].

Having broad principles which span the three different dimensions of sustainability, biodynamics can be applied across different contexts, terrains, and production systems. Furthermore, it seeks synergies with other sectors (Indicator 2.2.). In fact, many practitioners have established partnerships with schools, restaurants, hotels, medical and wellness facilities, unlocking the potential of community supported agriculture.

Looking at Criterion 3 of the IUCN Global Standard for NbS™ (net benefits to biodiversity and ecosystem integrity), several practices included in biodynamic agriculture contribute positively to its achievement. This approach values biological diversity within and between species. It relies on a diversity of local seeds and breeds that must be cultivated and promoted in all areas of the farm. Similar to permaculture, biodynamic agriculture also advocates for non-productive farm elements and asks that farmers set aside a minimum of 10% of their total farm area for biodiversity. This is in line with key policy goals at the EU level, such as the EU Biodiversity Strategy 2030 target of achieving "At least 10% of agricultural area is under high-diversity landscape features" (EC, 2020). In addition, the strict avoidance of synthetic pesticides and fertilisers make this approach biodiversity friendly. Lastly, it is also worth recalling that as biodynamic agriculture focuses on self-sufficient farms, the monitoring requirements of Criterion 3 can be respected.

However, indicator 3.4 (ecological connectivity) may not be well addressed. As mentioned, biodynamic agriculture views farms as self-contained and self-sustaining organisms, thus the interconnectivity dimension of ecosystems is less of a concern.

One of the key principles of biodynamics is the creation of economic value, aligning this approach well with Criterion 4 (economic viability). This approach looks at the economic viability of the farm as one element of a more complex regional value chain, and takes into consideration the international trade dimension. An established certification scheme, the Demeter Biodynamic Standard (Biodynamic Federation Demeter International, 2022), provides the possibility for farmers to gain market competitiveness. It must be noted however that, while growing, the uptake of this scheme is still limited both in terms of numbers and geographical distribution. Regarding the economic pillar of sustainability, biodynamic principles stress the need for a pricing structure that reflects the true cost of production. By doing so, the approach underscores two key considerations: that current prices in most cases do not take the ecological cost

9 The Demeter Standard is an agreement on the minimum requirements that a biodynamically managed farm must meet to be recognised as Demeter certified.

of a product into consideration, and that agriculture must provide fair conditions to those employed in this sector. This last point is important also for Criterion 5 (inclusive, transparent and empowering governance processes), as biodynamic agriculture fosters dialogues among practitioners and different stakeholders, so that the knowledge exchange benefits all members of the value chain.

An aspect of the IUCN Global Standard for NbS™ where biodynamic agriculture might score relatively low is Criterion 8 (mainstreaming). The spiritual and esoteric angle of this approach might hinder its uptake and its inclusion in key policy documents, as well the fact that other market-oriented labels (organic) have fared better with consumers.

**Summary**: Within biodynamic agriculture, the three pillars of sustainability are well addressed and reflected. Therefore, the alignment of this approach to the IUCN Global Standard for NbS™ is largely straightforward. However, there are some areas which could be further aligned with the concept of Nature-based Solutions. Not only Criterion 8, but also for example the need to enhance ecosystem integrity and connectivity (Indicator 3.4.).

## 5.5. Organic farming

*Definition*: "*A production system that sustains the health of soils, ecosystems and people. It relies on ecological processes, biodiversity, and cycles adapted to local conditions, rather than the use of inputs with adverse effects. Organic agriculture combines tradition, innovation and science to benefit the shared environment and promotes fair relationships and a good quality of life for all involved*" (IFOAM, 2008).

*NbS Alignment*: Organic farming is perhaps the most prominent and widespread approach to sustainable agriculture, as well as one of the few legally defined ones. This approach combines practices that have been carried out for millennia with more technological innovations. The environment is at the heart of the approach together with humans and ecosystem health. This is particularly relevant when looking at indicator 1.3 of the IUCN Global Standard for NbS™, which reads "*Human well-being outcomes arising from the NbS are identified, benchmarked and periodically assessed*". In fact, one of the core principles of organic agriculture concerns health, which has been described as follows by the international umbrella organisation for the organic sector (IFOAM, 2020): "*Organic Agriculture should sustain and enhance the health of soil, plant, animal, human and planet as one and indivisible*".

On the issue of scale (Criterion 2), organic agriculture benefits from its long-standing integration in national and international legislation. In the European Union, for example, the legal framework for this approach was codified in 1991. As guidelines and regulations have been developed, organic agriculture can now be implemented in several production types and in different geographic contexts. However, it must be noted that in some regions, due to lack of organic material, this option might not always be the optimal choice (Oberč & Arroyo Schnell 2020).

Regarding biodiversity and Criterion 3, organic agriculture aligns relatively well with the IUCN Global Standard for NbS™. The preservation of agrobiodiversity, the focus on soil health, the diversification of crop species and breeds, the care for animal welfare, the reduction of pesticides and the

maintenance of water quality all indicate a welcome focus on the environment. In addition, third party or group certification schemes are well established and a necessary step to be certified as organic farmer. Due to its wide uptake, organic agriculture already has several monitoring mechanisms in place to ensure the quality of the organic label. This helps to satisfy all of the indicators of the IUCN Global Standard for NbS™ calling for periodic monitoring, adaptive management and feedback mechanisms. For example, Indicator 3.2 asks that "*Clear and measurable biodiversity conservation outcomes are identified, benchmarked and periodically assessed*" (IUCN, 2020a).

Presently, organic agriculture has a strong market and, in most cases, it is an economically viable solution (Criterion 4). However, this particular approach has been criticised for lower yields compared to traditional agriculture (5-30%) (DG AGRI, 2023) and overall lower temporal stability (Knapp & van der Heijden, 2018). Yet, farmers can save significant amounts on fertilisers and pesticides. According to the EC, organic arable crop farms save 75-100% on plant protection product costs per hectare and 45-90% on fertiliser costs per ha compared to conventional farms (DG AGRI, 2023). Denmark's Organic Action Plan (OAP) (Heindorf, 2019a) highlights the potential of organic agriculture to create market demand, as a tool to bring stakeholders together, and to create a win-win solution. The Danish OAP was created through a year-long consultation promoted by the Minister of Agriculture which sought to merge all the needs of the sector, bringing together 200 stakeholders, through an inclusive governance process. The redirection of subsidies and the leveraging of public funds yielded interesting results. Copenhagen developed one of the most ambitious public procurement programmes in Europe and met the goal of 90% organic food in 2015, without an increase in meal prices (Heindorf, 2019b).

Analysing Criterion 8, organic farming could be assessed as "strong" in relation to indicator 8.2 (NbS informs and enhances facilitating policy and regulation frameworks to support its uptake and mainstreaming). Organic farming, especially in Europe, is well integrated into mainstream policy. For example, in 2021 the European Commission released an Action Plan for the Development of Organic Production (EC, 2021). The plan works on three axes to stimulate demand and ensure consumer trust, stimulate conversion and reinforce the entire value chain, and improve the contribution of organic farming to environmental sustainability. The plan was adopted in pursuance of the target of the EU Biodiversity Strategy for 2030 and the Farm to Fork Strategy to achieve "at least 25% of the EU's agricultural land under organic farming" (EC, 2020).

However, due to some structural limitations, this approach might struggle to achieve indicator 8.1 on transformative change. For example, the cost of transforming a farm from conventional to organic requires extensive resources in terms of time, energy, and cost. These costs might be abated in the long run due to market premiums, but as new labels arise the primacy of these options might be challenged. Moreover, some studies point out how these systems use more arable land and water to achieve the same yield as conventional agricultural practices, drawing its scalability into question (Miller, 2017; Dahan et al., 2014; Savage, 2015).

**Summary**: Organic agriculture can be closely aligned with the criteria of the IUCN Global Standard for NbS™. It is particularly strong in the environmental-economic pillar, while the social component could be enhanced. The approach focuses primarily on *how* to farm, while it has no direct principles linked to the strengthening of the governance process' inclusivity. This does not mean that social considerations cannot be attached to this type of farming, however it would need to be

assessed on a case-by-case basis. For similar reasons, namely the focus on the farm itself, an added emphasis on ecosystem integrity and connectivity, would further strengthen its alignment with Indicator 3.4 of the IUCN Global Standard for NbS™ (Opportunities to enhance ecosystem integrity and connectivity are identified and incorporated into the NbS strategy).

## 5.6. Conservation agriculture

*Definition*: "*Conservation Agriculture is a farming system that can prevent losses of arable land while regenerating degraded lands. It promotes maintenance of a permanent soil cover, minimum soil disturbance, and diversification of plant species. It enhances biodiversity and natural biological processes above and below the ground surface, which contribute to increased water and nutrient use efficiency and to improved and sustained crop production*" (FAO, n.d.-d).

*NbS Assessment:* Conservation agriculture, in contrast to the approaches analysed above, has a narrower focus as it deals predominantly with soil conservation. Soil degradation is a key issue in agriculture, and the IUCN report "Common Ground" outlines how conservation practices can revitalise our soils for the benefits of nature and farmers. Looking at the interaction between this approach and Criterion 1 of the IUCN Global Standard for NbS™ (addressing societal challenges), it can be said that conservation agriculture aims to address food security as well as climate change mitigation and adaption. Its three principles are:

- Minimising soil disturbance;
- Maintaining soil cover; and,
- Managing crop rotation.

While this approach conserves biodiversity and enhances carbon capture, it fails to give specific consideration to biodiversity and landscape elements. As a result, it lacks a focus on ecosystem integrity and connectivity, making the alignment with Indicator 3.4 questionable (Opportunities to enhance ecosystem integrity and connectivity are identified and incorporated into the NbS strategy). In addition, although it advocates for a decrease in fertilisers, conservation agriculture has often been criticised for its use of herbicides and for its overestimation of carbon sequestration (Larbodière et al., 2020).

Regarding Criterion 4, the approach can be economically beneficial for farmers due to the decreased use of certain machinery, fuel, and fertilisers. As an approach, conservation agriculture also does not delve much into questions of governance (Criterion 5) or adaptive management (Criterion 7), and due to its narrower focus, it is challenging to mainstream it in different jurisdictional contexts (Criterion 8). On the other hand, Oberč and Arroyo Schnell (2020) state that the approach "*can be implemented on any geographical terrain, on farmland used for the cultivation of crops*". This latter point, if complemented by a broad stakeholder engagement across sectors, could increase the alignment of the approach with the IUCN Global Standard for NbS™ Criteria 2 (design at scale) and 5 (inclusive governance).

**Summary**: Conservation agriculture rightly places an enhanced emphasis on the importance of healthy soils. Chapter 2 of this report outlined the concerning trend of soil degradation worldwide and the repercussions that this might have. Nevertheless, the narrow focus and the lack of consideration for agrobiodiversity beyond soils, make it difficult to align this

approach with the IUCN Global Standard for NbS™. Perhaps, if conservation agriculture is understood as sub-set of practices to be integrated and complemented by other nature positive measures, some of its key elements would contribute to the alignment of the overall approach to the concept of Nature-based Solutions.

## 5.7. Regenerative agriculture

*Definition*: "*Practices that regenerate soil, reducing but not necessarily eliminating synthetic pesticides and fertilisers, and going beyond the reduction of negative effects towards ensuring that agriculture has a positive effect on the environment*", FOLU (Pharo et al., 2019).

*NbS Alignment:* Regenerative agriculture is closely linked to conservation agriculture. It differentiates itself from the previous approach due to the inclusion of livestock farming, and not only crops, in its scope. Hence, regenerative agriculture includes pasture cropping, rotational grazing, and other practices aimed at stimulating plant growth and increasing carbon sequestration. The goal is to increase the resilience of agricultural yields through the optimisation of ecosystems services provided by a healthy environment. The approach not only addresses the societal challenges of food security, but also water security and quality, and ecosystem degradation (Criterion 1). Yet, the approach looks primarily at production practices and not at the entire food chain, overlooking some key social considerations or the overall need to reform the asymmetric power structures in the today's food system, analysed in previous chapters.

Regenerative agriculture has been gaining traction in the policy arena, as well as in several farming contexts around the world. Partnerships between local farmers and large corporations have been established and have elevated the profile of the concept in sustainable agriculture discourse. The nature of the approach makes it easy to implement on any geographical terrain as one of its key principles is "*adaptation to context-specific design*" (Criterion 2).

Regarding Criterion 3, regenerative agriculture focuses on soil health, seeks to ensure that agriculture has a positive effect on the environment, and strives to increase carbon storage and water retention. The approach encourages a reduction in synthetic pesticides, and features ecosystems health in two of its four key principles, partly following core principles of the One Health approach. In line with this, a recent report on NbS and decent work outlined how a potential impact of scaling up NbS in agriculture is the reduction of farmers' exposure to chemicals, with regards to weed and pest control, which would contribute to the reduction of many negative acute and long-term health risks (ILO, UNEP & IUCN, 2022). However, it must be said that in most cases the approach is implemented at the farm level, and it does not address the landscape level (indicator 3.4. Opportunities to enhance ecosystem integrity and connectivity are identified and incorporated into the NbS strategy). Additionally, regenerative agriculture does not take into consideration the need to integrate landscape elements and wildlife habitats in its scope (Oberč & Arroyo Schnell 2020). Furthermore, some critics reiterate some difficulties in measuring the overall positive contribution to biodiversity due to the selective focus on soils of regenerative agriculture (Oberč & Arroyo Schnell 2020).

Like conservation agriculture, the approach is not directly linked with the transparent governance and economic viability

dimensions, hindering its alignment with Criteria 4 and 5 of the IUCN Global Standard. Yet, some recent studies have highlighted the economic opportunities that can arise from scaling up regenerative agriculture and the constant evolution of this concept. One report shares some of the potential that this approach has in the African continent (Africa Regenerative Agriculture Study Group, 2021). Major companies, including AB InBev and Nespresso, have launched projects reaching more than 100,000 farmers. The findings show how regenerative agriculture promotes business growth through direct production and cost benefits for the agricultural sector, and via indirect impacts on the supply chain, while at the same time fighting climate change and protecting the environment.

Lastly, regenerative agriculture has gained significant traction over the past few years, making it easier to mainstream the concept in policy and jurisdictional context (Criterion 8). In the authors views, the political momentum should be underpinned by a strong scientific understanding of the approach to increase its potential and prevent its misuse.

**Summary**: Understood narrowly, regenerative agriculture is an approach that focuses mostly on soils and only marginally addresses broader environmental considerations. It would therefore be challenging to see how this approach could align with the principles at the basis of the IUCN Global Standard for NbS™. Nevertheless, regenerative agriculture could align with the concept of NbS through its constant theoretical evolution with the integration of key biodiversity-friendly practices, the compelling long-term economic and food security potential displayed by several case studies, the partnership with local communities, and a renewed attention on social considerations.

## 5.8. Carbon farming

*Definition*: "*Involves implementing practices that are known to improve the rate at which CO2 is removed from the atmosphere and converted to plant material and/or soil organic matter*" (Carbon Cycle Institute, n.d.).

*NbS Assessment:* Just like regenerative and conservation agriculture, carbon farming focuses on soils and on climate change mitigation; while having less of a focus on key environmental issues such as biodiversity loss. In the polarised debate of today, the general discussion around this approach tends to shift from its potential to address several societal challenges to an overreliance on carbon credits.

Carbon farming can be implemented at different scales, depending on which practice is being considered. According to the European Commission's Technical Guidance Handbook - setting up and implementing result-based carbon farming mechanisms in the EU, practices like agroforestry can be implemented in all farming systems, while others such as wetland rewetting are more context dependent (DG CLIMA, 2021). In addition, the EC outlines how, in larger schemes, one factor limiting scaling is the scope of the farm carbon audit tool to robustly measure emissions. This is a limitation that was acknowledged also in Approaches to Sustainable Agriculture (Oberč & Arroyo Schnell 2020).

While carbon farming focuses mostly on climate, several practices included in the early conceptualisation of this approach can also benefit biodiversity, and help to achieve Criterion 3 of the IUCN Global Standard for NbS™ (biodiversity net gains and ecosystem integrity), if duly incorporated. Those

carbon farming practices which can benefit biodiversity and enhance ecosystem integrity include: peatland rewetting, agroforestry, nature-inclusive management of grasslands, and wetland restoration (Nyssens, 2021). If these practices can fall under carbon farming, this approach would be in closer alignment with the principles of Nature-based Solutions. However, carbon farming which focuses solely on soil management, is unlikely to satisfy the requirements to be considered a Nature-based Solutions.

The ever-expanding policy framework surrounding this approach, including the EC Proposal for a Regulation on an EU certification for carbon removals (DG CLIMA, 2022), makes it easier to align it with Criterion 8 on mainstreaming. Moreover, the creation of carbon markets, coupled with a growing portfolio of public and private funding, could well align it with Criterion 4 (economically viable). It must be noted, however, that carbon markets have been the subject of some criticism. The difficulties in monitoring the effectiveness of offsetting schemes and the misuse of these mechanisms have raised concerns among environmentalists and civil society about the risk of greenwashing (Greenfield, 2023). Lastly, the contribution of carbon farming to the social pillar of sustainability is limited (Criterion 5). The ongoing work at the European level does involve several stakeholders and ensures a greater level of transparency, however more work is needed to increase the robustness of this approach. As new funding opportunities are developed, special access rules that facilitate the inclusion of small farms in result-based carbon farming schemes could be established (Nyssens, 2021).

**Summary**: Carbon farming could be better aligned with the concept of NbS provided that two additional considerations are reflected. Firstly, the understanding of the approach could place a stronger emphasis on practices that bring biodiversity benefits. For example, under the European Environmental Bureau's understanding of carbon farming: "*land management practices which reduce GHG emissions and increase the sequestration and storage of carbon in soils and vegetation. To do so while also benefitting biodiversity, water, and farmers' livelihoods, carbon farming must adopt a holistic approach towards healthy soils and healthy ecosystems, grounded in the framework of "nature-based solutions*" (Nyssens, 2021). Through this definition we see once again how a growing number of actors are recognising the interlinkages between agriculture, environment, and NbS. Secondly, the approach could look beyond the economic and environmental pillars of sustainability, to ensure that the widespread application of its practices is inclusive for all stakeholders.

## 5.9. Climate-smart agriculture

*Definition*: "*CSA aims to enhance the capacity of the agricultural systems to support food security, incorporating the need for adaptation and the potential for mitigation into sustainable agriculture development strategies*", FAO (Lewis, 2019).

*NbS Alignment:* Since its launch, climate-smart agriculture has been focused on tackling two key societal challenges (Criterion 1): food security and climate change. The concept is scalable and, like NbS, it is context- and capacity-dependent, making it adaptable to any geographic conditions. In addition, the aim of climate-smart agriculture is to relate actions on the farm with the governance and market framework surrounding it, in line with the requirements of Criterion 2 of the IUCN Global Standard for NbS™.

In terms of biodiversity net gain and ecosystem integrity (Criterion 3), however, the approach may score poorly. One of the principles of climate-smart agriculture is to reduce GHG emissions and enhance carbon sequestration. While the approach mentions the preservation of ecosystem services, this is mostly as it relates to climate mitigation and not biodiversity conservation. While it is true that the restoration of peatlands and degraded land is included in possible practices, these are very location-specific measures, and the theoretical basis of the approach does not mention biodiversity benefits.

Concerning economic viability (Criterion 4), the core principles of climate-smart agriculture are oriented towards increasing agricultural productivity and income for farmers. The types of international players backing the approach also underscore the economic focus of the approach. However, the breadth of its conceptualisation makes it challenging to point to specific measures for analysis. The same can be said for the inclusion of social safeguards in the approach, and on the need for transparent governance (Criterion 5). It must be noted that several civil society advocates have been critical of the approach as, in their view, it allows business as usual agriculture to continue under a new title (Climate Smart Agriculture Concerns, 2014).

Originally promoted by the FAO, climate-smart agriculture is deeply rooted in policy and international cooperation, making it easy to be mainstreamed in multilateral strategies and policy documents (Criterion 8). Other key international organisations are backing this approach, including the European Union, the World Bank, the International Fund for Agricultural Development (IFAD), the United Nations Environment Programme, and the World Food Programme.

**Summary**: Overall, the alignment with IUCN Global Standard for NbS™ criteria is relatively low and lacks a focus on biodiversity. Nevertheless, with a series of complementary measures, the implementation of CSA could align with the principles of Nature-based Solutions. The case study on cardamom farming highlights which practices have been put in place to strengthen the alignment of this approach with the IUCN Global Standard for NbS™.

## 5.10. High-nature value farming

*Definition*: "*High Nature Value (HNV) farming is a relatively new concept that has been developed since the early 1990s as a policy tool to describe those farming systems in Europe which are of greatest biodiversity value. Instead of focusing only upon the maintenance of rare or endangered species and habitats on protected sites, the HNV concept recognises that the conservation of biodiversity in the EU also depends to a great extent upon the continuation of specific farming systems and practices across much wider areas of the countryside.*" (European Commission (EIP-AGRI, 2016).

*NbS Alignment:* The concept of high-nature value (HNV) farming, as a distinct approach to farming, was born in the 1990s in Europe to recognise the beneficial interconnectedness of biodiversity and traditional low intensity farming systems. Per se, the approach does not address any societal challenges beyond biodiversity conservation. According to the IUCN Global Standard, if an action only addresses environmental degradation and biodiversity loss, it cannot be considered an NbS. Thus, for HNV farming to be considered an NbS and to align with Criterion 1 (societal challenges), the approach should contribute to another challenge, such as climate change

mitigation (Schmitz et al., 2023) and/or food security. In terms of social values that the approach creates one could count support to ecosystem services and importantly cultural identity. In fact, losing HNV farming practices would also lead in many cases to a loss in traditional knowledge, which could be considered an important societal challenge.

Practical application of this approach is found almost exclusively in remote agricultural land in Europe and, besides certain commodities, high-nature value farmers often work in difficult socio-economic conditions, which adds to the pressures of abandoning these practices (EIP-AGRI, 2016). This complicates the alignment with Criterion 4 on economic viability, although the EU Common Agricultural Policy continues supporting HNV farming. Work has been carried out to mitigate this concern. A 2016 EIP-AGRI report (EIP-AGRI, 2016) identified 5 pathways to support a more socio-economically viable HNV farming, these are:

- Networking and cooperation
- Farm diversification
- Increasing the selling price of HNV farming products and improving access to markets
- Adopting new technologies
- Increasing the physical output of the farm (within specific constraints)

Several of the elements in these pathways stress the need for more innovative and inclusive governance. If achieved, this would allow the approach to better align with Criterion 5 (transparent governance) (EIP-AGRI, 2016).

Though not immediately apparent, HNV farming is well aligned with the IUCN Global Standard for NbS™ in relation to Criteria 3 (biodiversity net gains and ecosystem integrity) and 8 (policy mainstreaming). Several methods that are listed as practices under this approach have proven biodiversity benefits, such as nature conservation set asides and planned blooming strips. Furthermore, the very nature of the approach makes it so that farmers must take a landscape approach and interact with different elements, placing particular attention on the provision of key environmental services such as carbon storage, clean water, wildfire prevention, storage of genetic diversity, and cultural value (EFNCP, n.d.). For these reasons, the European Commission has included HNV farming as an environmental indicator in its Common Agricultural Policy. Furthermore, high-nature value farming has also been added to the list of potential eco-schemes under the 2021-2027 CAP published in January 2021 (DG AGRI, 2021). As a result, the approach becomes a clear link between policy and practice, in line with indicator 8.2 "*The NbS informs and enhances facilitating policy and regulation frameworks to support its uptake and mainstreaming*". Unfortunately, despite this policy support, some argue that national implementation fails to halt the decline in HNV farming systems and their biodiversity (Keenleyside et al., 2014).

**Summary**: High-nature value farming faces several challenges in alignment with the principles of the IUCN Global Standard for NbS™. The current financial and policy incentives are not sufficient to provide HNV farmers with a stable economic profit. While Criterion 3 on biodiversity and Criterion 8 on mainstreaming are mostly aligned with NbS principles, many others are not. For example, Criterion 2 on the design at scale is hard to align due to the nature of the approach. While the concept has been predominantly confined to Europe, it would be valuable to apply it in other contexts. In 2022, IUCN released a publication aiming to contribute to mainstream HNV farming, titled "*Catalogue of Ecosystem-based Adaptation measures in mountains: Experiences using Nature-based Solutions to build climate resilience in mountain communities of South America, Asia and Africa*" (IUCN, 2022).

## 5.11. Low external input agriculture

*Definition*: "*Production activities that use synthetic fertilizers or pesticides below rates commonly recommended for industrial tillage agriculture. It does not mean elimination of these materials. Yields are maintained through greater emphasis on agronomic practices, integrated pest management, and utilisation of on-farm resources (especially labour) and management*", FAO (Bélanger & Pilling, 2019).

*NbS Alignment*: Low external input agriculture (LEIA) is a sustainable agricultural approach that aims to reduce the use of inputs and optimise the use of biological resources. It does not specifically seek to address societal challenges. However, it could be argued that in some developing countries this approach contributes to mitigating environmental degradation and to promoting socio-economic development. Even if biodiversity tends to be higher than in conventional farms, the approach is not specifically focused on net gain and ecosystem integrity (Criterion 3), but instead at the minimisation of inputs that prove to be detrimental to ecosystems.

LEIA has a historical focus on empowering smallholders and local communities, and some of its key socio-economic principles include the guarantee of sustained farmer livelihood systems, enhanced food security at the family and local level, and contribution to employment generation. This aligns well with the socio-economic considerations of Criteria 4 and 5 of the IUCN Global Standard for NbS™. It must be noted however that this approach is associated with higher labour and less output (Graves, Matthews & Waldie, 2004). Nevertheless, when considering the value of ecosystem services and the lower expenditure on inputs, the economic losses could be mitigated (Bélanger & Pilling, 2019).

When it comes to Criterion 8, the uptake of LEIA has been increasing but at a slow pace and in an uncoordinated manner. The challenges that farmers face in implementing this approach are unlikely to facilitate the mainstreaming of LEIA in the policy arena.

**Summary**: It is challenging to foresee an alignment of this approach to the principles of Nature-based Solutions. This is primarily because this would require a fundamentally different understanding of the concept. It does have a focus on smallholder farmers in developing countries, which is worth emphasising and supporting.

## 5.12. Circular agriculture

*Definition*: "*The concept of circularity originates from industrial ecology (Jurgilevich et al., 2016), which aims to reduce resource consumption and emissions to the environment by closing the loop of materials and substances. Under this paradigm, losses of materials and substances should be prevented, and otherwise be recovered for reuse, remanufacturing and recycling. In line with these principles, moving towards a circular food system implies searching for practices and technology that minimise the input of finite resources, encourage the use of regenerative ones, prevent the leakage of natural resources (e.g. carbon (C), nitrogen (N), phosphorus (P), water) from the food system, and stimulate the reuse and recycling of inevitable resource losses in a way that adds the highest possible value to the food system*" (De Boer & van Ittersum, 2018, based on Jurgilevich et al., 2016).

*NbS Alignment*: Circular agriculture recognises that the current production system is not optimised and that resources are generally wasted where they could be recycled and reused. The Ellen MacArthur Foundation estimates that a circular economy for food could reduce the sector's GHG emissions by 49% and by 2050 cut 80% of the 16 million tonnes of synthetic fertilisers used every year by reducing waste and closing nutrient loops (EMF, 2015; EMF 2021). It aims to restore soil health, support biodiversity, and mitigate greenhouse gas emissions. The circular approach is thus looking at addressing some key societal challenges while reducing costs for farmers. The approach can be applied in various terrains and production systems, aligning itself well with Criterion 2.

Circular agriculture openly advocates for a re-organisation of our agricultural production systems and indirectly calls for a shift to plant-based diets, arguing that the space that this transition would free up can be devoted to nature conservation. The approach also looks at genetic diversity and at using different natural processes to convert waste. It does not include specific measures to enhance ecosystem integrity or for biodiversity net gains (Criterion 3), but practices and approaches like agroforestry, organic farming, and mixed farming can be considered in circular agriculture (Helgason, Iversen & Julca, 2021).

In terms of Criterion 4 (NbS are economically viable), the approach takes into consideration different earning models and seeks to adapt its measures to the socio-economic context, depending on the availability of resources (Thigssen, 2018).

Wageningen University & Research considers circular agriculture as "*a collective search by farmers, interested citizens, businesses, scientists, and researchers for the optimum combination of ecological principles with modern technology, with new partnerships, new economic models, and credible social services*" (Thigssen, 2018). Yet, the social component of this approach can and should be enhanced if circular economy were to align with Criterion 5 (inclusive governance) of the IUCN Global Standard for NbS™.

While the approach was first theorised in the 1990s, business models to support it still need to be developed, and evidence of many legal obstacles at jurisdictional level (for example in the waste sector) have been observed (Oberč & Arroyo Schnell 2020). This makes it challenging for the approach to achieve Criterion 8 (mainstreaming), however an overhaul of the current economic system and a transition to a circular economy that begins and ends in nature (Oberč et al., 2022) could facilitate the uptake of the approach.

**Summary**: This approach could be aligned with the concept of NbS. To enhance biodiversity measures, including practices like agroforestry and dedicating more space for natural features, the farm unit could take a more central role in circular agriculture. It would be also important to strengthen the social component, for example by ensuring a transparent governance process throughout all stages of the NbS implementation. Complementary to this, facilitating smallholder recognition of their practices as circular could increase the uptake of the term.

## 5.13. Ecological intensification

*Definition*: "*Optimal management of nature's ecological functions and biodiversity to improve agricultural system performance, efficiency and farmers' livelihoods*" (FAO, n.d.-b).

*NbS Alignment*: Ecological intensification has two main goals: to preserve ecological processes and enhance biodiversity conservation, and to increase agricultural yields. By optimally managing the agroecosystem, this approach looks to tackle the challenges of food security, water security, climate change, and biodiversity conservation (Criterion 1). Ecological intensification can be applied in different regional contexts and it can be applied in several production systems. However, as it currently stands, the model has yet to be proven adaptable or scalable (Oberč & Arroyo Schnell, 2020). This makes it challenging to foresee an alignment with Criterion 2 (design at scale).

Biodiversity conservation (Criterion 3) is a core principle of the approach. It looks at improving soil fertility and reducing the risk of pest and disease infestations through natural processes, decreasing the use of harmful inputs, and reducing negative health and environmental externalities linked to synthetic pesticides and fertilisers. For example, a study by Kovacs-Hostyanszki shows that ecological intensification has the potential to mitigate impacts of conventional intensive land use on pollinators and pollination by bringing ecosystem services into crop production systems, and replacing chemical inputs (Kovács-Hostyánszki et al., 2017). Ecological intensification also strives to diversify the genetic variety of the farming system to make it more resilient to climate change.

Looking at the economic viability of the approach (Criterion 4), ecological intensification aims to increase the income and economic stability of farmers. The approach is labour intensive but a reduction in inputs would also mean a reduction in costs for farmers. However, since it looks at the landscape as a whole, Oberč and Arroyo Schnell (2020) state that a full transition to this model requires institutional innovation, serious investment, long-term commitment, and collective decision-making. In the same publication, the FAO is quoted as stating that research needed to reduce yield gaps could focus on ecosystem-based adaptation solutions tailored to specific agricultural contexts. Here, a better understanding of how NbS could be integrated into ecological intensification could help to fill this knowledge gap.

On transparent governance, the approach is likely to be aligned with Criterion 5, as one of its core principles requires "Increasing participatory involvement of stakeholders and collective decision-making" (Wezel et al., 2020). This presupposes the integration of governance transparency and inclusivity.

Lastly, on policy and jurisdictional mainstreaming (Criterion 8), ecological intensification is still far from being mainstreamed in key international strategies. Nevertheless, its approach to the socio-economic and environmental pillars of sustainability could help to achieve different global targets such as SDGs 1 (End Poverty) and 2 (Zero Hunger) or Target 10 of the Kunming-Montréal Global Biodiversity Framework[10].

**Summary**: Scalability remains an issue in the practical implementation of this

10 TARGET 10: Ensure that areas under agriculture, aquaculture, fisheries and forestry are managed sustainably, in particular through the sustainable use of biodiversity, including through a substantial increase of the application of biodiversity friendly practices, such as sustainable intensification, agroecological and other innovative approaches, contributing to the resilience and long-term efficiency and productivity of these production systems, and to food security, conserving and restoring biodiversity and maintaining nature's contributions to people, including ecosystem functions and services. https://www.cbd.int/doc/decisions/cop-15/cop-15-dec-04-en.pdf

approach, but this hurdle could potentially be overcome with additional policy efforts to mainstream this concept. The environmental criterion is respected but similarly to many other approaches, the focus on the farm level makes it challenging to foresee how ecological intensification would help to achieve indicator 3.4 on ecosystem integrity and connectivity. The social dimension of the approach is also not well aligned with the criteria of the IUCN Global Standard for NbS™.

## 5.14. Sustainable intensification

*Definition*: "*An approach wherein yields are increased without adverse environmental impact and without the cultivation of more land*" (The Royal Society, 2009).

*NbS Alignment*: The origin of sustainable intensification can be traced back to the 1990s; it was developed to support smallholder farmers in Africa to increase productivity. The approach focuses on increasing yields, while minimising the impacts on the environment. A growing human population and the competing demands for space make this approach interesting as it attempts to increase efficiency of global agriculture without increases in agricultural land. To achieve this, several inputs (knowledge, machinery, labour) can be maximised. It can be understood that sustainable intensification aims at halting environmental degradation while ensuring food security (Criterion 1).

It must be noted, however, that this approach does not seek to enhance biodiversity and ecosystem integrity per se, nor does it specify how the increase in productivity should be achieved. This ambiguity has led criticism of the approach from those who view it as a means for agribusiness to continue harmful practices (Oberč & Arroyo Schnell, 2020). Sustainable intensification takes into consideration some aspects of agroecology, organic farming, precision farming, urban farming and more. However, the lack of clarity surrounding the term raises doubts as to its actual effectiveness, and the difficulties in measuring the environmental impacts of such an approach complicate its understanding.

Theoretically, the economic component (Criterion 4) could be well respected, provided that farmers have the necessary tools to implement the approach. On the other hand, sustainable intensification does not explicitly mention social sustainability (Criterion 5). Additionally, it is focussed on farming methods and not on the transparent governance processes that might support its implementation.

Yet, the approach is included, together with agroecology, as the only other approach specifically mentioned in the newly adopted Kunming-Montreal Global Biodiversity Framework (CBD, 2020). Target 10 defines the practice as biodiversity friendly and states:

> "*Ensure that areas under agriculture, aquaculture, fisheries and forestry are managed sustainably, in particular through the sustainable use of biodiversity, including through a substantial increase of the application of biodiversity friendly practices, such as* ***sustainable intensification****, agroecological and other innovative approaches contributing to the resilience and long-term efficiency and productivity of these production systems and to food security, conserving and restoring biodiversity and maintaining nature's contributions to people, including ecosystem functions and services*".

This explicit reference will facilitate the uptake of this approach in policy and in different jurisdictional contexts in the upcoming decades. It is also well aligned with indicator 8.3 of the IUCN Global Standard for NbS™ (2020): *"Where relevant, the NbS contributes to national and global targets for human well-being, climate change, biodiversity and human rights, including the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP)"*.

**Summary**: Contrary to several other approaches, sustainable intensification looks to further intensify while reducing agricultural land expansion, in line with the concept of land sharing. While it can be considered a sustainable agricultural approach, sustainable intensification in principle does not align well with the prerequisites of Nature-based Solutions. Criterion 3 on biodiversity net gain and ecosystem integrity, a key one for NbS in agricultural contexts, is insufficiently addressed by sustainable intensification. To better align with Criterion 5, the approach would also largely benefit for a renewed focus on issues of transparent governance. The approach is now enshrined in the highest international biodiversity strategy, the Kunming-Montreal Global Biodiversity Framework, yet, the assessment of sustainable intensification leaves some doubts as to its contribution to biodiversity and social sustainability. A transition from sustainable to ecological intensification, presented above, could perhaps be better aligned with the overall vision of *Living in Harmony with Nature* under the Kunming-Montreal Global Biodiversity Framework.

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# 6. Case studies: Examples of the use of IUCN Global Standard for NbS™ in agriculture

***The following case studies have been selected from online databases, pre-existing publications, and projects. The aim of this section is to present solutions to concrete problems faced by farmers on a daily basis. The case studies have not been validated by IUCN and thus for the time being can only be considered as potential NbS.***

## 6.1. Biodiversity loss and protection of cultural heritage (Lemnos Island, Greece)

Preservation and promotion of the traditional practices of the primary sector of Lemnos[11]

The Terra Lemnia Project is coordinated by the Mediterranean Institute for Nature and Anthropos (MedINA) and aims to directly contribute to the sustainable development of Lemnos Island through the conservation and selective re-introduction of semi-extensive agro-pastoral practices of the traditional *mandra* system, and the celebration of its products and practitioners as part of the island's living heritage. The Lemnian mandra is a traditional mixed-farming system and the epicentre of the agro-pastoral lifestyle of the island. It consists of an array of farming structures – barns, fenced yards, living and storage spaces, milking and cheese making facilities, threshing floors – along with the crop fields and pastures, managed by the "kehaghias", the traditional farmer-stockbreeder of Lemnos. The project used the IUCN Global Standard for NbS™ and the self-assessment resulted in a score of 67% match with the criteria, here are some highlights.

**Criterion 1**: As a viable alternative between the two dominant trends of agricultural intensification and abandonment, the project addresses two societal challenges:

- Environmental degradation and biodiversity loss: by supporting biodiversity, sustainable land management and stewardship, and preventing desertification; and
- Economic and social development: by supporting local livelihoods and culture, preventing land abandonment and rural depopulation, halting the loss of traditional knowledge, providing incentives against the intensification of farming practices, and supporting farmers against exposure to unfair market competition due to the lack of strong cooperative structures.

**Criterion 2**: Initial design and implementation of the intervention has been based on extensive fieldwork and continuous consultation with local stakeholders, including local authorities (Regional

11 Dimopoulos et al., 2022; Georgiadis et al., 2022.

Department of Rural Economy, Municipality of Lemnos), the two local agricultural cooperatives (Enosi and Atsiki), local civil society actors (NGO Anemoessa being a project partner), universities (the University of Aegean being a project partner) and beneficiaries, including many farmers and local businesses. Synergies have been actively sought across all sectors affecting the NbS since the early stages of the project. Most notably, multi-level consultations have taken place with local associations and businesses to support the process of product branding and promotion.

**Criterion 3**: Design and implementation of the intervention has been based on extensive ground proofing work on the state of local ecosystems, biodiversity and landscape. This was done through interdisciplinary work that combines field surveying of biodiversity and soils condition, recording of local knowledge through questionnaire surveys, interviews and workshops, land cover change analysis based on satellite imagery and analysis of secondary data sources. This work has allowed the project team to assess the impacts of farming practices on biodiversity, soils and landscapes, to select bio-indicator species that will be used as the basis for a cost-effective long-term monitoring system, to identify drivers of landscape change and biodiversity loss, and to produce a detailed record of the traditional mandra system, its practices and products. Conservation targets have been set at farm level, providing a minimum (mandatory) threshold for conservation of semi-natural vegetation and traditional farming structures. A higher (optional) figure based on restoration or introduction of such elements, along with other obligatory measures with direct or indirect impact on the state of ecosystems (e.g. polyculture, rotational grazing, etc.) was also set. The intervention supports specific practices, such as reduced tillage, residues retention, maintenance of traditional farming structures, extensive crop rotation, intercropping and on-farm agrobiodiversity conservation among others. This has proven beneficial for ecosystem and landscape integrity, local ecosystems and species based on fieldwork findings. The above measures have been integrated into a "Standard of good practices", later developed as a certification and labelling system titled "Terra Vita – Agricultural Traditional and Biodiversity". The system allows for periodic revisions, in case monitoring shows insignificant – or even adverse – Impacts to local ecosystems from the implementation of specific practices.

**Criterion 4**: A market analysis has been carried out to identify the market potential of several products of the traditional mandra system and a feasibility study has followed. It identified the main steps needed for the creation of a strong local brand for the selected priority products and analysed the potential benefits for all involved stakeholders. The preparation of a business model, based on a detailed cost-effectiveness study and analysis of international benchmarks, would be an important step for long-term sustainability of the system. From the market side, the project team placed emphasis on the certification and labelling system "Terra Vita – Agricultural Tradition and Biodiversity", as this can provide visibility and added value to the local products.

**Criterion 5**: The Land Stewards Network, a voluntary network of farmers, is being developed in full consultation with all involved stakeholders to ensure that the rules for participation are well understood and commonly accepted. A stakeholder mapping and engagement plan has been carried out through systematic consultation at the local level to ensure recording of all views and ownership of results from all affected stakeholders. Open stakeholder workshops and events have also been organised to bring all stakeholders together to discuss issues of common concern and co-develop proposals for supporting the local farming sector and its traditional practices and

products. The stakeholder engagement plan outlines potential roles and benefits of each stakeholder group from their participation in a local quality agreement.

**Criterion 6**: The intervention fosters a semi-extensive agro-pastoral system, as a viable middle ground model between the two dominant trends of agricultural intensification and abandonment. In this respect, the "Standard of good practices" and the related certification scheme indicate that the economic viability of the system cannot be ensured without accepting a degree of intensification, and this can be considered as the main trade-off of the intervention.

**Criterion 7**: The intervention works to constantly adapt and evolve in order to achieve sustainability of results at two levels. At the community level, the aim is to engage a wide range of actors in the form of a local quality agreement. At the farmers' level, the aim is to develop a functional network bound together by a commonly agreed set of practices based on the concept of land stewardship.

**Criterion 8**: Overall, the intervention addresses several national and global targets for human wellbeing, but there is no mechanism for systematically recording and reporting relevant project impacts towards their achievement. However, policy proposals in support of local products and practices have been developed in collaboration with affected local stakeholders, and awareness raising actions have been organised with local schools and cultural associations. A draft proposal for the establishment of locally relevant agri-environmental measures based on the "Standard of good practices" was submitted to the Greek Ministry of Rural Development and Food for review. Lastly, the project led to the inscription in several national lists and to the registration of the local breed of sheep, of crop landraces, local products, and of the traditional mandra system in the National Inventory of Intangible Cultural Heritage.

The third phase of the intervention is part of the 'Terra Graeca' programme, and Lemnos continues to be a key focal area. Seminars and lectures in schools showcased the agri-food Intangible Cultural Heritage of Lemnos. The marketing of Terra Vita products is being further operationalised and smallholders continue to be empowered by promoting on-farm artisanal production and culinary tourism. 'Via Lemnia' is funded by the Hellenic Ministry of Culture and Sports; it will see the development of another four food trails, which will be also accessible online and On-farm biodiversity conservation activities such as the improvement of hedges and nesting sites for birds.

## 6.2. Environmental degradation and poverty (Lachuà Ecoregion, Guatemala)

Agroforestry systems for sustainable cocoa farming in the Lachuá Ecoregion[12]

This Nature-based Solution intervention, included in the PANORAMA database, focused on cocoa agroforestry[13] systems in the Lachuà Ecoregion of Guatemala. It was carried out by IUCN, which has a good understanding of the local societal challenges, having worked in the region for over 20 years.

**Criterion 1:** The most prominent challenges that this intervention aimed to address included, poverty, human well-being, and environmental degradation were. These were identified in consultation with local communities and stakeholders, most of whom are part of the Indigenous Q'eqchi' ethnic group. An assessment of livelihood options that provide economic, social, and environmental benefits identified cocoa agroforestry systems as the most desirable option, also due to cocoa's cultural value for Q'eqchi' Mayans. This NbS intervention focused on shifting towards more sustainable agricultural practices for cocoa agroforestry systems, while looking to the value chain as a whole (production, processing, marketing, logistics, technical assistance and services, increased access to public and private funding mechanisms and investments). Furthermore, the tourism and private sectors were also engaged in the project to facilitate the mainstreaming of good practices into business models.

**Criterion 2:** Two sets of action were developed, at the local and national levels. The former ensured tailored approaches and the context-specific implementation of NbS. The latter focused on mainstreaming organizational and technical capacities at a broader scale.

**Criterion 3:** Due to the longstanding presence of IUCN in the region, various studies on the status of ecosystems already existed. These served as a baseline to understand the positive outcomes for biodiversity of the NbS intervention. In particular, the Restoration Opportunities Assessment Methodology (ROAM) and the InVEST tool were used to provide evidence of direct and co-benefits. Numerous studies reported increased biodiversity through implementing agroforestry (Udawatta, Rankoth & Jose, 2019), and this NbS in particular resulted in several benefits:

- 303 ha restored from traditional monocrops to cocoa agroforestry systems in areas of high value for conservation;
- land-use change to agroforestry systems contributed to GHG emissions reductions of 9,320 tons of CO2e (1,864 tons of CO2e per year; 80% increase in CO2e storage in terrestrial biomass, such as trees and roots, and 20% in soils);
- erosion reduction between 33.8 and 107.7 tons per ha;
- sedimentation reduction between 0.03 to 4.6 tons per ha depending on the land-use prior to cocoa agroforestry;
- improved forest connectivity, increased plant cover, new sightings of birds and other species absent in traditional crops;
- absence of chemical contamination from the use of industrial agricultural inputs.

**Criterion 4:** To fulfil Criterion 4, IUCN carried out a financial and economic analysis in order to develop a sustainable business model for the project. It created a framework for

12 Meyer, 2022.

13 In the Oberč and Arroyo Schnell 2020 report, agroforestry is not considered as a sustainable agriculture approach. It is grouped together with a set of practices that are implemented in different approaches and are thus horizontal. Agroforestry can be found, for example, in agroecology, nature-inclusive agriculture, permaculture, ecological intensification, low external input agriculture, circular agriculture, and biodynamic agriculture.

agricultural and manufacturing practices, good governance and access to financing, innovation and the market (including international markets). Commercial contracts were established with 36 businesses from the United States, Belgium, South Korea, and others The National Strategy for the Cocoa Value Chain improved the marketability of the product in the international market value chain. The cocoa was also certified under the USDA organic certification scheme.

Key economic benefits:

- Farm production yields improved by 152% (293 kg per ha per year);
- Due to the improved quality of the cocoa, it was possible to increase the price from USD 2.28 to USD 4.50 per kg;
- Sales of export-quality products increased from 0 to 47 tons per year with average annual sales above USD 170,000;
- At least 315 permanent jobs created (289% increase in comparison to the 2015 baseline);
- Average family income reached USD 1,411 per year (an increase of 342% of the average daily income per capita);
- 180 ha of sustainable cocoa agroforestry systems were incorporated into the national incentive programme.

**Criterion 5:** Throughout the duration of the project, consultations, participatory approaches, and the free, prior and informed consent (FPIC) principle were applied. In particular, local community associations were created and strengthened in close coordination with formal organisational structures (community councils for development). New employment opportunities were generated, especially for Q'eqchi' Maya youth and women, covering the value chain of production. The technical team included the government of Guatemala, local NGOs and actors involved in the cocoa value chain. A total of 898 producers and technicians developed technical skills for sustainable agricultural and manufacturing practices (20% women). Particularly young women and men profited and became recognised leaders as they got involved in technical, managerial and administrative activities. The initiative also won the 2018 IUCN Impact Award for social Inclusion, celebrating the engagement strategy for women and youth.

**Criterion 6:** The formalisation of land tenure rights in the 1990s, which involved local cocoa producers in the Lachuá Ecoregion, was a key enabling condition for the NbS intervention. An analysis of the environmental and economic benefits of different land uses was conducted and informed the selection of agroforestry options. Local and Traditional Knowledge from the local Indigenous Q'eqchi' community was particularly valuable in agreeing the limits of trade-offs. Specifically, the approaches and intended benefits were agreed with nine producer associations, Fundalachuá and several service providers. The development of an agricultural calendar for cocoa cultivation in northern Guatemala contributed to increased accountability and transparency of production chain processes.

**Criterion 7:** For the NbS intervention, a monitoring and evaluation framework was put in place that provided feedback loops throughout the project intervention cycle, so that approaches could be adapted accordingly, in line with Criterion 7 (adaptive management).

**Criterion 8:** Lessons learned from the NbS intervention in Lachuá, especially the generation of financial, economic, and environmental benefits as key criteria to prioritise landscape restoration at the national level, contributed directly to the inclusion of cocoa agroforestry in the National Strategy for the Cocoa Value Chain. The Government of Guatemala established an incentive programme to finance investments in and maintenance of cocoa agroforestry systems based on clear technical

parameters for management plans of such systems. A follow-up project in Guatemala was also established with 1,000 producers, achieving the restoration of 776 ha of land. The Government has also defined a national goal of 15,000 ha of land to be dedicated to cocoa agroforestry systems.

## 6.3. Climate change and biodiversity loss (Kangchenjunga, Nepal)

Demonstrating climate smart agriculture to enhance the resilience of large cardamom farmers in the Kangchenjunga transboundary landscape[14]

Cardamom is a key niche product for farmers in the Kanchenjunga Landscape: a high-altitude landscape that spreads across Nepal, India, and Bhutan. The ongoing environmental crisis presents people in the region with several societal challenges, both environmental and socio-economic ones. To counter them, the International Centre for Integrated Mountain Development (ICIMOD) started the Rural Livelihoods and Climate Change Adaptation in the Himalayas (Himalica) Project. This particular case study is located in Taplejung, Nepal.

**Criterion 1:** Climate change, biodiversity loss, decline in pollinators, soil degradation, and viral diseases are putting the livelihoods of Nepalese cardamom farmers at risk. At the same time, market volatility threatens income stability for many in the region. The case study and potential NbS intervention proposes climate resilient agricultural practices as viable, long-term solutions for farmers in the region. The intervention was carried out by ICIMOD, government agencies and a wide range of stakeholders.

**Criterion 2:** The project centred on twelve farms, but through this established partnership it looked beyond, to synergies with the entire food chain. For example, one of the outcomes was the CARDAMONIA market strategy. This included the development of cardamom mix soft drinks and cardamom-based products and their promotion by a chain of village cafés and restaurants.

**Criterion 3:** In the initial stages, the project carried out ecosystem assessments of large cardamom-based farming systems to gain insight into ecosystem health and impacts of climate change. The project trained farmers in implementing a series of practices, including:

- promotion of local varieties that are resilient to extreme weather conditions;
- promotion of organic agriculture, including the development and use of Jholmal – a homemade bio-pesticide and bio-fertilizer made from green manure and cow urine;
- mulching and inter-cropping to maintain soil health/organic matter;
- use of mobile technology to disseminate information on soil types, disease and pest management, an on timing for planting crops.

The adoption of these practices, in combination with the rotational harvesting of shade trees, the integration of beekeeping, legumes, and other crops, resulted in several biodiversity benefits. For example, this included an improved abundance of natural pollinators, better growth of large cardamom plants, and less consumption of fuel wood. The rehabilitation of two natural ponds led to improved water retention in the soil and the growth of lush green vegetation.

14 Sinha & Bimson, 2021.

**Criterion 4:** Farmers were also provided with information on the market prices and the status of supply and demand for large cardamom. To dry the cardamom pods, the farmers were provided with energy-efficient dryers almost twice as fuel-efficient as the previous dryers. To increase farmers' income, the project enabled the development of other market-ready products derived from cardamom (e.g. tea mix and spice powder). The intervention resulted in a 50% increase in the productivity of large cardamom yields, from 112 kg/Ha to 163 kg/Ha, contributing to an increase in annual household income from 600 to 770 USD.

**Criterion 5:** Participatory approaches were used throughout the design, implementation, and monitoring of the project to encourage community ownership. Putting communities at the heart of all of these projects ensured that what was implemented was well-suited to the local context, with direct benefits for local people. Bringing the private sector into community engagement processes can also deliver benefits and strengthen relationships. The project had a focus on women and youth, ensuring meaningful participation and leadership by women was crucial to the success of the project due to their importance as natural resource managers. Women in this community have first-hand experience in addressing natural resource distribution issues and long-term risks as they plan for the future of their families, while also possessing much of the local knowledge and skills vital to address these challenges. Their long-term perspectives can contribute to better monitoring of risks and outcomes. Therefore, a series of trainings workshops focusing mainly on women entrepreneurs was organised to develop value-added products with the brand name 'Himalica-Green Products from the Mountains.' To boost the "Spice Garden Tourism" model, local youths were trained in homestay tourism, hospitality management, and as trekking guides. Through these efforts, the project supported farmers in producing and selling value-added products from cardamom pods: this resulted in an increase in household income from cardamom by 50%-100%.

**Criterion 6 and 7:** Since the three pillars of sustainability are well addressed by this project, the information on the intervention suggests that the balance of the trade-offs between achievement of their primary goal(s) and the continued provision of multiple benefits has been considered. Further data on the effective and adaptive management of the intervention is needed for a better alignment of this project in the Kangchenjunga region with Criterion 7 of the IUCN Global Standard for NbS™.

**Criterion 8:** The project ran from December 2012 to March 2018. However, following a request from the local municipal government, it supported the development of a Strategic Action Plan and Vision for Agriculture Development (2018-2023) for the Taplejung municipality. The plan is well suited to inform policymaking and trigger transformative change as it is aligned with Nepal's Agriculture Development Strategy (2015- 2035).

## 6.4. Grassland degradation and desertification (Ganjia, China)

Ganjia Grassland Ecological Management in China [15]

**Criterion 1:** Climate change has resulted in global grassland degradation and desertification, loss of biodiversity, and subsequently in economic losses. Pastoralists in Ganjia have established a system based on ensuring a symbiosis between humans and nature. This system is closely related to the most pressing societal challenges in pastoral areas, including climate change adaptation and mitigation, economic and social development, and ecosystem degradation and biodiversity loss.

**Criterion 2:** Based on the relatively large climate variability and spatial heterogeneity in local natural conditions, pastoralists in Ganjia have chosen a governance method that combines pasture sharing with four-season rotational grazing. In the management of this intervention villages act as the core governance unit. They decide on the use and management of pastures in a different time and space based on a consideration of interactions between the economy, society, and ecosystems. The process requires both spontaneous actions of local pastoralists and management and coordination by tribal villages, so as to explore which methods fit with local conditions.

**Criterion 3:** Despite the lack of in-depth research to examine the ecological benefits generated by the Ganjia Grasslands, both the observations of local pastoralists and scientific monitoring data have indicated a recovery of wildlife species diversity in recent years. The fenceless land use on the shared pastures, as well as the openness of saline-alkali soils and other natural resources have increased the integrity and connectivity of the grassland ecosystem. The main ecological benefits include:

- Despite the hot and dry climate in Ganjia Grasslands, during the maximum grass growth period from July to August in 2018, local average vegetation cover exceeded 70%, and the growth of grass exceeded that of neighbouring towns with similar climate conditions, such as Wangge'ertang;
- In 2020, the average hay yield in Ganjia Grasslands reached 1,975.67 kg/ha;
- Wildlife species, such as alpine musk deer, snow leopards, sand cats, black storks, and black-necked cranes, have been recorded in the area.

**Criterion 4:** Based on local conditions, pastoralists in Ganjia have adopted multiple grazing strategies such as renting pastures, or adjusting the livestock structure to improve the returns from grazing while ensuring the sustainable use of pastures. Meanwhile, measures such as trade quotas have diversified funding for pasture governance in a sustainable way. The short-term livestock-free strategy created by local pastoralists not only serves as a flexible adaptation to market changes, but also brings forth new business opportunities, namely, "Tibetainment" with idle pastures. This case has provided a reliable basis and a viable reference for others to bolster their practices and governance in grassland agricultural production.

**Criterion 5:** Governance for the Ganjia Grasslands case is based on negotiations between local pastoralists, and with local communities, which is key for the area to implement NbS. Villages in Ganjia have established a complete decision-making process and an open negotiation platform. The main decision-maker (i.e., the pasture management group) and the implementer (i.e., the patrol group) are elected by village collectives. These elections are formulated based on the individual situations of

15 CCICED, 2022

the community and through voting by representatives from each household, which reflects inclusiveness and ensures fairness for all pastoralists. In addition, as a group distinctly formed through lineage and geographical ties among the tribes, local villages perform activities that cannot be accomplished by individual pastoralists. These activities include traditional identity-related rituals, and group-based essential activities like sheep shearing and house building, creating an influential atmosphere that bonds pastoralists from different backgrounds more closely.

**Criterion 6** Villages in Ganjia treat collective and long-term interests as the primary goal in pasture management and make decisions based on majority rule. The pasture sharing and four-season rotational grazing are the most important features of the current ecosystem governance in Ganjia Grasslands. These methods have been retained following their continuous practice, in consideration of the collective interests of the pastoralists in ensuring that these stay intact. In cases where any individual pastoralist disrupts the collective harmony and stability, the village may consider their reasonable requests, e.g., providing a separate pasture, while excluding them from group activities, in the interest of maintaining overall stability and the continued realisation of multiple benefits.

**Criterion 7:** Villages in Ganjia mainly rely on experience and adaptive local ecological knowledge to define the rules for hire pasture according to local conditions, which is conducive to rapid ecosystem recovery. The management and patrol groups spontaneously organised by local village collectives can track problems encountered in implementing NbS more swiftly and solve them in time. In the face of unpredictable changes in the environment, policies, and markets, local pastoralists have adjusted accordingly by spontaneously designing flexible solutions, such as pasture leasing and the short-term livestock-free strategy, with feedback provided on the local NbS system.

**Criterion 8:** In the pastoralist communities of Ganjia, villages are bonded through long-term reciprocal relationships, which are essential to local grassland governance. They share experiences and build knowledge together, thus ensuring the sustainability of these measures. The experience of Ganjia Grasslands in NbS practices has produced ecological, environmental, economic, and social benefits, which serve as a reference point for other regions, and may be incorporated into national or regional strategies as a policy for long-term implementation that can be efficiently applied to practices in other regions.

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# 7. Conclusions and recommendations

Since 2008, experts have shaped NbS through publications, stakeholder workshops, political negotiations, interventions, and projects on the ground. The International Union for Conservation of Nature continues to play a key role in this discussion by providing a strong scientific basis and standard setting. For example, the NbS definition launched in 2016 and development of the IUCN Global Standard for NbS™ in 2020, which includes a set of overarching principles. Due to their global reach, but the need to be implemented in local contexts, both of these instruments took a top-down/ bottom-up approach.

Following these necessary first steps, an important task now is to outline guidance on how the IUCN Global Standard for NbS™ can be applied to different sectors across the landscape, in order to devise holistic solutions that break the silos of conservation actions.

Building on the gaps outlined in the text and through several interactions with stakeholders, it is evident that NbS are first and foremost actions, thus the absence of an action should in principle not be considered a Nature-based Solution. Different reports from a wide range of stakeholders tried to fit examples like “avoided grassland conversion” or “avoided wood fuel harvest” in the category of NbS. These might be benefits that arise from the implementation of a Nature-based Solution, but they are in principle not NbS themselves.

Turning to the IUCN Global Standard for NbS™, the present report and its case studies have shown that biodiversity benefits, and ecosystem integrity in particular, play a crucial role in the context of Nature-based Solutions. Hence, when implementing NbS in the agricultural sector – **beyond the need to ensure compliance with the overall criteria of the standard –, it is strongly suggested that each component of Criterion 3 should be at least adequately met in the IUCN NbS self-assessment tool**. To guide implementation, IUCN is working on an NbS guidance document for agriculture projects, to explain step by step how the IUCN Global Standard for NbS™ should be applied in an agriculture context. This is due to be issued in 2025, as the first formal sectoral guidance for projects under the IUCN Global Standard for NbS™.

An analysis of the alignment between each sustainable agricultural approach and the criteria of the IUCN Global Standard shows an interesting dynamic. **A group of sustainable agriculture approaches place biodiversity at the core** of their theoretical basis **(agroecology, nature-inclusive agriculture, regenerative agriculture, biodynamic agriculture, and organic farming)**. Their focus is not only on preserving, but also enhancing biodiversity, including agrobiodiversity. These approaches look at the broader landscape, taking into consideration the economic dimension, and have the possibility to be applied easily at scale. They therefore show strong alignment with the criteria of the IUCN Global Standard for NbS™ and, provided that they are implemented respecting the criteria on the ground, **these approaches seem to align quite well with the concept of Nature-based Solutions.**

The other approaches look at the environment in more generic terms and might therefore be more limited in their alignment with the concept of NbS. Some approaches, like conservation agriculture and carbon farming, place more attention on soil; others are specifically focused on climate benefits, such as climate smart agriculture. Some look more at the farm level (permaculture, sustainable intensification, ecological intensification), while others might have more policy and financial challenges for their implementation, e.g. circular agriculture, high-nature value farming and low external input agriculture.

It should be reiterated that the goal of this publication was not to create a hierarchy of sustainable agricultural approaches; their context-dependent nature makes any such direct comparisons impossible. It was stated multiple times that, **in any case, any of the 14 approaches, even where they do not align fully with the IUCN Global Standard for NbS™, still present a better alternative than modern conventional farming.**

In any case, to better align the approaches with the criteria of the IUCN NbS Global Standard for NbS™ – especially for those approaches that might be less aligned with it –, and **to promote the uptake of Nature-based Solutions in agriculture more generally, several measures could be considered** for each sustainable agriculture option.

To enhance biodiversity net gain and ecosystem integrity, **farmers can implement the supporting transversal practices that have been identified as sustainable in the relevant literature**, such as crop rotation, the inclusion of cover and companion crops, mixed crop and intercropping, reduction of synthetic pesticide and mineral fertiliser use, no or minimal tillage, lower livestock densities, managed grazing, free range, crop diversification, mixing farming and forestry, mixed crop and animal farming, nutrient balancing, recovery and reuse, the inclusion of landscape elements such as hedgerows and flower strips, agroforestry, or ecosystem restoration.

To support their economic viability, **public and private investors can prioritise the deployment of NbS over conventional solutions**. Financial instruments that cater to the sometimes longer NbS timeframe should be made available, making it easier to transition investors' mindsets from short-term temporary fixes to long-term solutions. In this context, and as part of this measure, **the redirection of harmful agricultural subsidies should benefit NbS and smallholder farmers. This could be through granted public support and easier access to grant mechanisms and loans to face any potential additional investments needed to apply Nature-based Solutions**. Indeed, a set of nature positive incentives, redirected from the current unsustainable subsidies' schemes, could boost the uptake of NbS.

There are **multiple case studies that can serve as governance examples to farmers and other stakeholders**. This report presents some of those examples which can serve as best practices to consider. For example, the multi-stakeholder dialogue and the respect of the principle of Free Prior and Informed Consent (FPIC) in Lachuà Ecoregion (Guatemala), the coordinated decision-making process in the Ganjia Grasslands (China), and others. These are diverse scenarios that can help farmers to determine which governance model might suit them best.

Some relevant case studies revealed a concerning trend in relation to the loss of traditional knowledge globally. This was particularly pronounced in the TERRA LEMNIA case study (Lemnos Island, Greece) or in the analysis of high-nature value farming but can also be observed in other instances. Historically, indigenous and traditional knowledge has sometimes been

overlooked by the scientific and policy debates. In the potential implementation of NbS, it is paramount that project managers and farmers take into consideration, if applicable, other equally viable forms of knowledge.

Moreover, policy will play a fundamental role in the promotion of Nature-based Solutions in agriculture. In this context, **it would be useful to consider a specific stream of work on agriculture and Nature-based Solutions in the three Rio Conventions**. Furthermore, the integration of the IUCN Global Standard for NbS™ in the monitoring, reporting and reviewing mechanisms of the Kunming-Montreal Global Biodiversity Framework would strengthen the scientific basis of its targets, particularly Targets 8 and 11 where NbS are explicitly mentioned.

In the European Union, which aims to be a leader in environmental issues (e.g. with the launch of the European Green Deal in 2019), and where the Common Agricultural Policy plays a key role in its 27 Member States, **the integration of NbS would help to increase policy coherence across the different components of the European Green Deal.** With regard to future reforms of the EU Common Agricultural Policy, **a stronger integration of NbS in the next Multiannual Financing Framework beyond 2027 would be needed**. The IUCN Global Standard for NbS™ can be useful here, as a tool in ensuring that the necessary safeguards in the implementation of NbS are respected.

Finally, it is important to emphasise that this report responds to the IUCN Members' request expressed in Resolution 7.007 calling on the IUCN Secretariat to prepare a report on agroecological practices as Nature-based Solutions. Following this resolution, **IUCN recommends its Members and key international organisations active in this field** (FAO, IPBES, IPCC, the High-Level Panel of Experts on Food Security and Nutrition (HLPE), the International Partnership for the Satoyama Initiative (IPSI), and others) **to use this publication as a key source for the Nature-based Solutions discussions in future.**

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