Annex 1. Barriers

Public awareness and societal mindsets

1. A societal mindset refers to a set of assumptions, views and philosophies that influence how societies organise themselves, take decisions and set long-term goals. A wide variety of factors are currently preventing societies from developing mindsets that lead to ecosystem restoration being a central consideration within their long-term development planning. The main factors are described in brief below.

2. *Awareness of the impacts of degradation*. Most people globally are not aware of the full extent to which many different types of ecosystem degradation are negatively impacting the wealth of their society, their own well-being and their human right to safe, clean, healthy and sustainable ecosystems[1,2]. The global costs of this degradation are extreme, with lost ecosystem service values estimated to be US$6.3–10.6 trillion a year[3]. The general lack of awareness is partly because ecosystem services such as nutrient cycling, pollination and water provision are not taken into account in most market transactions in, for example, the agricultural sector[4]. The physical disconnect between people living in cities and nature further contributes to this lack of awareness (highlighting the need for green spaces and ecosystem restoration within urban areas).

3. It is also not commonly understood that without investments in large-scale ecosystem restoration, the negative effects of degradation are likely to greatly increase and compromise the well-being of present as well as future generations. Linked to this is a general underappreciation of the benefits of investing in large-scale ecosystem restoration. Focussing solely on the economics, returns from investments in ecosystem restoration are exceptionally high for society at large: ~50 per cent for tropical forests, ~20 per cent for other forests, ~42 per cent for shrublands, and ~79 per cent for grasslands over a 40-year time period[5].

4. *Societal beliefs and behaviours*. Systems of knowledge and the ways in which a society understand its relationship with nature, and values (or undervalues) ecosystems, are deeply embedded in social and cultural behaviours, traditions, and belief systems. These knowledge systems influence how ecosystems are appreciated and to what extent their value is incorporated into decision-making at individual, household, local, national and international levels. The outcome is often that short-term, local outcomes are prioritised at the expense of long-term, global outcomes. Importantly, social science research shows that simply increasing awareness of the negative effects of degradation and long-term economic benefits of ecosystem restoration is not guaranteed to alter the way ecosystems are valued or change how decisions affecting ecosystems are made.

5. Decisions prioritising short-term, local outcomes may be because of: i) a lack of awareness of the long-term negative impacts; ii) entrenched behaviours (in some cases based on cultural and spiritual beliefs) that may have been sustainable prior to increased human populations and expansion/industrialisation of value chains; iii) poverty or short-term survival needs limiting alternative options, even when the long-term negative impacts are known and appreciated; and/or iv) real or perceived economic benefits of these activities and how society discounts their economic, environmental and social value.

6. *Simple and negative messaging*. The inherent complexities of how ecosystems function, how they are degraded, and how they can be restored makes effective communication challenging especially to a diverse audience. As a result, the messaging in this regard is often simplified, with the threats of degradation more prominent in the media than the opportunities for ecosystem restoration. This, in turn, leads to reporting on global environmental concerns being predominantly negative and devoid of the hope provided by ecosystem restoration.

1. IPBES Land degradation assessment collaboration. 2018. The IPBES assessment report on land degradation and restoration. Bonn: Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES). Available at: https://www.ipbes.net/assessment-reports/ldr
2. IPCC. 2018. Global warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty.
3. ELD Initiative (2015). The value of land: Prosperous lands and positive rewards through sustainable land management. Available from www.eld-initiative.org.
4. The Economics of Ecosystems and Biodiversity. 2015. TEEB for Agriculture & Food: Towards a global study on the economics of eco-agri-food systems. Geneva: UN Environment. Available at: http://www.teebweb.org/wp-content/uploads/2013/08/Towards-TEEBAgFood_15May2015.pdf
5. Ibid

7. *Awareness of the drivers of degradation and their frequently diffuse nature*. Drivers of degradation in most ecosystems are usually both direct and indirect[6,7], with both types needing to be addressed to make meaningful progress on protection and restoration of ecosystems. Direct drivers, include natural events (e.g. earthquakes, volcanic eruptions, extreme weather events, droughts, tropical cyclones and floods), and anthropogenic activities (e.g. changes in land and ocean use, resource extraction, pollution of freshwater resources and oceans, introduction of invasive alien species and emission of greenhouse gases). Indirect drivers include societal values and behaviours such as demographic factors (e.g. human population dynamics), socio-cultural factors (e.g. social beliefs, inequalities, marginalisation of certain groups, value systems and consumption patterns), economic factors (e.g. environmental externalities not being priced into goods/services, energy/agricultural subsidies having major unintended negative impacts on ecosystems, and demands from natural resource based-livelihoods), technological factors (e.g. advances in industrial and agricultural technologies) or factors relating to institutions, governance, conflicts and epidemics.

8. It is usually difficult to pinpoint a moment in time and space where one action was responsible for ecosystem degradation that then impacted negatively on an individual's well-being, including their health and livelihood. Degradation, with its negative effects, is rather woven into the fabric of how societies function and interact globally. For example, demand for animal products and plant products on one continent can, in a diffuse manner, catalyse extensive degradation of grasslands, forests, and wetlands on another continent, whilst also contributing to global problems such as pollution of the atmosphere and world's oceans. Given the complexity and inherent uncertainties within such pathways of degradation, it is a communication challenge to explain in clear and precise terms to governments, corporations and individuals how their collective actions are causing degradation, and how the associated diffuse negative impacts have created a crisis threatening the well-being of billions of people. Similarly, it is difficult to communicate in simple terms why the diffuse forces of degradation need to be countered and why major investments into ecosystem restoration are necessary.

The linkages between communities producing and consuming food in different parts of the world are particularly important for restoration practitioners globally to identify and address. For example, there is a danger that local communities that clear land in intact ecosystems in order to produce food crops for export are perceived as causing the degradation of ecosystems and needing to take responsibility for the restoration of those ecosystems. Communicating the collective responsibility across supply chains is consequently of critical importance for the global restoration community.

9. *Abstract, generalised messaging*. It is difficult to generalise about how to restore degraded ecosystems and what the benefits of ecosystem restoration will be because these details can vary markedly across regions and landscapes. This often results in messaging on ecosystem restoration being abstract and at a scale too large to be readily appreciated, as opposed to being anchored to a specific place. The credibility and the digestibility of messages on ecosystem restoration for the general public tend to consequently be diminished.

10. *Lack of consensus on how to define ecosystem restoration*. The complexity of ecosystem restoration has prevented global organisations and governments reaching consensus on a definition of ecosystem restoration, what terminology to consistently use, and what scientific principles to adopt for restoring ecosystems effectively. This has prevented the global community mapping out a clear ecosystem restoration vision for the future, with detailed goals and targets for individual ecosystems. It has also prevented leaders working on different global challenges that would benefit substantially from large-scale ecosystem restoration initiatives (such as climate change, biodiversity, food security, water security, poverty and human health) speaking about the global ecosystem restoration opportunity in an integrated manner.

11. *Messaging not tailored for diverse audiences*. The cross-sectoral and multi-disciplinary nature of ecosystem restoration means that messaging needs to be tailored for a wide variety of audiences, spanning different age groups, genders, professions, cultures, languages and livelihoods. A common approach for organisations working on ecosystem restoration is, however, to present the messages in a manner that is easily absorbed by people with a background and strong interest in ecosystem restoration, as opposed to a manner that would resonate with, for example, rural subsistence farmers, or staff within ministries of finance. Reasons for this include for example insufficient resources for generating the wide range of messaging that is necessary and a lack of capacity to undertake the type of tailoring of messages required.

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6. IPBES Land degradation assessment collaboration. 2018. The IPBES assessment report on land degradation and restoration. Bonn: Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES). Available at: https://www.ipbes.net/assessment-reports/ldr
7. IPBES (2019): Global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. E. S. Brondizio, J. Settele, S. Díaz, and H. T. Ngo (editors). IPBES secretariat, Bonn, Germany.

12. *Access to information*. Even if messages are tailored appropriately, it is often difficult for marginalised groups such as girls, women and indigenous peoples to receive the information effectively. Challenges for such groups include a lack of formal schooling (and associated illiteracy) and/or insufficient resources to access information through routes such as newspapers, radio and the internet.

13. *The diverse array of ecosystem restoration benefits.* The public is usually poorly informed on the full range of benefits that arise from investments in large-scale ecosystem restoration partly because the benefits are so diverse, span numerous economic sectors and scientific disciplines, accrue over large areas, generate public as well as private goods, and often only fully materialise many years, even decades, after the intervention. This makes compiling a comprehensive overview of the benefits challenging. Ecosystem restoration of a degraded ecosystem can, for example, generate benefits for sectors such as: crop farming, through increased soil quality and pollination services from insects: livestock farming, through increased availability of fodder; domestic water supply, through increased infiltration of rainwater into aquifers; tourism, through improved landscape aesthetics; small businesses, through increased supply of products harvested sustainably from ecosystems; disaster risk reduction, through improved functioning of ecosystem services such as coastal defences against storm surges; and the health sector, through the reduced prevalence of vector-borne diseases and reduced exposure of the general public to air and water pollutants.

14. *Access to markets for natural resource-based small medium and micro enterprises (SMMEs)*. It is frequently difficult for local communities to capitalise fully upon the products generated within restored ecosystems (e.g. fish, non-timber forest products, fodder, and timber) because access to the appropriate markets is constrained. Marginalised groups such as women and indigenous peoples are often particularly constrained in this regard because of *inter alia* an unsupportive policy/legislative environment and lack of financial resources.

15. *Analysis of benefits and trade-offs in isolation.* Given that the long-term benefits of ecosystem restoration accrue to different sectors of society, if they are analysed, the analyses are usually done in silos in different government departments, university departments, think tanks, business groups, farmer groups, international conventions and NGOs. Furthermore there is seldom the diverse array of experts (from numerous disciplines) available for undertaking the highly specialised work needed to give a full picture of the likely benefits and trade-offs of large-scale ecosystem restoration for society as a whole. Such work includes for example quantifying: the increased supply of public and private goods; the economic multiplier effects from the use of these goods; and the increases in tax revenues for governments through time.

16. *Negotiations on trade-offs*. For most ecosystems, there is usually a relative scarcity of information on the full suite of benefits and trade-offs from large-scale ecosystem restoration. As a result, the trade-offs are seldom presented for discussion and negotiation across different sectors at local, national or international fora. This problem is compounded by: information on the benefits and trade-offs not being available in a format that can be easily digested by stakeholders spanning numerous sectors; a shortage of platforms for in-depth cross-sectoral discussion on public and private investment decisions on ecosystem restoration; and a limited number of facilitators with the appropriate skillsets for managing negotiations on trade-offs across sectors.

17. *Insufficient recognition of ecosystem restoration champions*. The general lack of awareness of the importance of ecosystem restoration for the well-being of current and future societies means that people who are making major contributions to ecosystem restoration initiatives are seldom given local, national or global recognition. There is consequently a general scarcity globally of ecosystem restoration champions – people who can be role models for those wanting to make a significant contribution to ecosystem restoration and who can raise the profile of ecosystem restoration within society as a whole.

Women and girls, in particular, are often well positioned to be ecosystem champions within local communities in rural areas because of the role they play in managing natural resources whilst producing food and managing fuelwood supplies. Laws and customs in many ecosystems, however, prevent women from owning or inheriting land and taking decisions on land use. As a result, their role as ecosystem champions is often greatly constrained.

18. *Absence of ecosystem restoration in education curricula*. Ecosystem restoration is not commonly taught in formal education systems across the world, and consequently most people do not have the nuanced understanding of the underlying principles to form an educated view on its global importance. Additionally, groups who are heavily engaged with and reliant on ecosystem resources – including women, girls and indigenous peoples – often do not have access to knowledge on ecosystem restoration. This is primarily because of unequal education opportunities and such groups not having access to conventional sources of information (e.g. newspapers, internet).

Dissemination of knowledge that depends on writing and reading, for example, does not engage illiterate groups – of which women and girls and indigenous groups make up a large proportion.

19. *Complex narrative for investors*. The complexity of the full suite of benefits from large-scale ecosystem restoration, including their long-term nature and the inherent uncertainties associated with them, usually prevents a simple narrative being given to investors. This is despite the business case often being compelling, once the full suite of long-term benefits of ecosystem restoration are fully analysed.

20. *Public Private Partnerships models needed for ecological infrastructure*. In some ecosystems, the business case for ecosystem restoration is compelling for private sector investors, whilst in other ecosystems, the benefits include a mix of public and private goods, which are more suited to a public private partnership or an intervention funded solely with public funds. Structures for managing combined public and private sector investments into ecosystem restoration are, however, usually either not available at the national level or require a lot of time and investment to establish. Such structures have historically been tailored for investments in grey infrastructure such as roads, buildings and dams, as opposed to ecological and other green infrastructure generated by investments in ecosystem restoration.

21. *Scarcity of global or local funds focussed on ecosystem restoration*. There are only a few funds globally – either in the process of being established, or operational and disbursing funds – that focus on assisting ecosystem restoration practitioners to develop bankable business plans for ecosystem restoration, to implement ecosystem restoration and/or to source additional appropriate investors. As a result, most ecosystem restoration practitioners globally do not currently have easy access to funders that are prepared to work with them to quantify and package the benefits of large-scale ecosystem restoration in a format that is appropriate for investor scrutiny.

22. *Access to commercial finance*. Even where business cases for restoration, based on private sector income streams, are compelling, it is usually difficult to raise finance from commercial banks or finance institutions. This is because of *inter alia* the length of time required to repay the loan, the uncertainty inherent in the trajectory of ecosystem recovery and the scarcity of ecological knowledge amongst staff in the institutions involved.

Political will

23. Numerous factors conspire to prevent sufficient political will developing at local, national and international scales to catalyse investments in large-scale ecosystem restoration. The main factors are described in brief below.

24. *Public pressure on leaders*. For reasons described above, there is usually minimal public pressure on leaders to comprehensively analyse numerous ways of using a particular ecosystem (including large-scale ecosystem restoration) and to view large-scale ecosystem restoration as a long-term investment into the future well-being of their society. Leaders are in particular not being pressurised to quantify the long-term benefits and cross-sectoral trade-offs of different ways of using ecosystems prior to their decision-making.

25. *Short-term benefits of degradation*. Activities which yield short-term benefits but degrade ecosystems are often perceived in a positive light by the general public, partly because the long-term or spatially disconnected costs of degradation and the full suite of benefits of large-scale ecosystem restoration are poorly understood. In some countries the system of Natural Capital Accounting has been introduced to rectify this information gap by mainstreaming ecosystem services valuation into decision-making processes. Implementation of this system has been constrained by the complex, interdisciplinary nature of ecosystem services valuation as well as limited political will and capacity. This constraint has been felt most acutely in developing countries where detailed information on the costs and benefits of competing land-use options is urgently needed but is often not available.

26. *The daunting scope of ecosystem restoration*. The scale and wide range of requirements – such as technical skills, funding, land area, governance structures and value chains – for large-scale ecosystem restoration is often perceived to be daunting by the general public and decision-makers.

27. *The perceived risk*. The complexity, and associated uncertainty with large-scale ecosystem restoration in many ecosystems, often results in a general perception by the public and decision-makers that the risks involved with such investments are too great.

28. *Conflicting interests*. In some ecosystems, conflicts may arise between groups wanting to protect ecosystems, extract natural resources or sustainably harvest ecosystems. These conflicts can involve stakeholders such as government institutions, civil society, rights-holders and indigenous peoples with historical claims to natural resources. Mediation of such conflicts requires specialised skills and an in-depth understanding of the political

environment, with its associated power dynamics. Marginalised groups with minimal political power are often critical partners in restoration initiatives. Elevating their status in the mediation process is consequently an important part of effective conflict resolution for implementation of long-term, large-scale and sustainable ecosystem restoration.

29. *Short-term political cycles*. There is a major disconnect between the long-term benefits of ecosystem restoration that accrue over decades and the short-term political cycles in many countries, where power may shift from one political party to another in the space of four to five years. The use of direct democracies and citizen assemblies could help overcome this barrier, but these mechanisms do not exist in most countries.

30. *An environmental as opposed to developmental agenda*. Some decision-makers in governments and corporates perceive large-scale ecosystem restoration to be an environmental agenda to conserve biodiversity rather than an investment that will yield numerous social, economic and environmental returns for society. Such decision-makers tend to see the evidence that large-scale ecosystem restoration can yield considerable returns across sectors such as agriculture, water supply and health as being too weak and uncertain for serious consideration. The absence of cost-benefit analyses as part of decision-making processes in many countries places a further constraint on including these broader considerations into policy decisions.

31. *Linking local interventions to global initiatives*. Local ecosystem restoration initiatives that are given prominence on the global stage because of the contribution they are making to international causes tend to garner more political support locally than initiatives that do not get global recognition. It is, however, currently difficult for local initiatives to be recognised internationally because of a relative scarcity of platforms for sharing ecosystem restoration experiences with the global public.

32. *Insufficient investment into infrastructure required for ecosystem protection and restoration*. Large-scale restoration in terrestrial as well as marine environments often requires significant investment in infrastructure and running costs for operating seed banks, nurseries, herbaria and laboratories.

33. *Limited coordination among authorities*. Large-scale restoration requires considerable cross-sectoral coordination within a country and often also between countries. Such coordination is frequently missing and constrained by a lack of trans-boundary goals and agreed upon standards for ecosystem restoration.

Technical Capacity

34. *Diversity of expertise*. Large-scale ecosystem restoration within any ecosystem invariably requires close collaboration amongst a wide range of individuals and organisations equipped with a diverse array of skills as well as technical knowledge specific to that ecosystem. In many ecosystems there is an insufficient number of individuals and organisations with the necessary skills and knowledge, as well as inadequate access to technology and data. The types of capacity that are often missing in large-scale ecosystem restoration initiatives can be divided into three categories, namely the enabling environment, organisational capacity and individual capacity, as outlined below.

35. *Enabling environment*. The enabling environment category includes capacity for society to develop appropriate: political commitment and visions; policy, legal and economic frameworks; national public-sector budget allocations and processes; governance structures; incentives; and social norms. The organisational category includes the capacity of a wide range of public as well as private organisations pertaining to management (functions, structures and relationships), operations (processes, systems, procedures, incentives and values), human and financial resources (policies, deployment and performance), knowledge and infrastructure. Lastly, individual capacity refers to people with the necessary knowledge, mindsets, technical skills and managerial skills. Marginalised groups such as women, youth and indigenous peoples are often lacking this capacity because of unequal opportunities in terms of access to education and information.

36. *Cross-cutting capacities*. Technical capacity (relating to the social, economic and environmental factors to be considered during the design, implementation and maintenance of restored areas) is a cross-cutting need that spans the enabling environment, organisations and individuals. Functional capacity is also cross-cutting. This type of capacity enables local, subnational and national institutions to plan, lead, manage and sustain ecosystem restoration initiatives effectively and to ensure that technical knowledge is embedded in the initiatives. It also equips the institutions to undertake long-term research on the ecosystem restoration and to use the results of the research to adjust protocols being used by the ecosystem restoration practitioners. Examples include capacities to: formulate and implement policies; access, generate, manage and exchange information; engage in networks, alliances and

partnerships; and implement programmes through effective cross-sectoral planning, budgeting, monitoring and evaluating.

37. *Capacity for initiating ecosystem restoration*. The capacities of the enabling environment, organisations and individuals are strongly dependent on the availability of knowledge with regards to designing, implementing and sustaining large-scale ecosystem restoration initiatives. Capacity constraints related to this availability of knowledge and frequently encountered in upscaling ecosystem restoration initiatives are outlined in the table below.

Technical capacity which is often unavailable and consequently constrains ecosystem restoration initiatives
Policymakers who have the capacity to:
Identify how current government policies (national, local and sectoral) are affecting processes of degradation as well as ecosystem restoration, both nationally and globally.
Reform and harmonise government policies and legislation to catalyse ecosystem restoration (including empowering and incentivising landowners, de facto land users, land managers, land custodians and/or local communities to embark on large-scale ecosystem restoration),to integrate ecosystem restoration targets into national climate and biodiversity goals, and to promote cross-sectoral management of ecosystems (including the integration of the science of ecological restoration into policy).
Reform tenure systems for land, freshwater and marine environments to be inclusive for marginalised groups (e.g. under-represented racial and ethnic identities, indigenous peoples, women and girls) and to incentivise local communities to invest in ecosystem restoration activities that will yield short- as well as long-term benefits.
Support the development of legal and policy frameworks to guarantee the human right to a safe, clean, healthy and sustainable environment (including ensuring the full, meaningful, informed and effective participation of rights-holders such as indigenous peoples and local communities) in decision-making related to the protection, sustainable use and equitable distribution of the benefits of healthy ecosystems.
Develop policies that protect and respect the cultural, religious, spiritual, aesthetic and recreational values associated with ecosystems (including the human rights to culture and freedom of religion, and the right of the child to play) and the rights of indigenous peoples and local communities to their traditional knowledge, lands, resources and territories.
Governance and planning experts who have the capacity to:
Develop appropriate, inclusive and gender-responsive governance structures to devolve sufficient power and resources to the local communities undertaking ecosystem restoration.
Undertake community-based landscape/resource use planning and decision-making that is gender responsive and inclusive of marginalised groups.
Facilitate commitments from stakeholders to fund ecosystem restoration and develop mechanisms for the stakeholders to hold one another accountable to the commitments.
Develop equitable cost and benefit sharing models for stakeholders.
Strengthen and/or establish extension support services and local producer organisations on ecosystem restoration.
Develop local institutional frameworks that are suitable for implementing long-term research and undertaking frequent adaptive management based on the data collected.
Develop appropriate governance mechanisms to manage the restored ecosystems for decades ahead.
Facilitate collaboration between institutions involved in specific ecosystem restoration initiatives to build synergies and avoid duplication.
Establish supply chains that enable local communities to implement ecosystem restoration initiatives in a cost-effective and commercially viable manner.
Experts in facilitating dialogues, communication and partnerships who have the capacity to:
Develop mechanisms for cross-sectoral cooperation and coordination on ecosystem restoration initiatives among government agencies at local, subnational and national levels in an inclusive and gender-responsive manner.
Communicate the costs, benefits and trade-offs of ecosystem restoration to decision-makers and the general public.
Develop platforms for cross-sectoral negotiations on the trade-offs involved with large-scale ecosystem restoration in an equitable and participatory manner (with the end goal being consensus among local stakeholders on the mosaic of habitat types and land/ocean uses that are appropriate given the local socio-economic and environmental conditions).
Develop and implement gender-responsive methods for empowering women and girls in dialogue, planning, decision-making and implementation of ecosystem restoration. This includes taking gender-differentiated access to physical spaces (e.g. for workshops and meetings) and information into account, and ensuring appropriate representation of women's and girls' voices in discussions on ecosystem restoration.
Facilitate fine-scale participatory planning (after consensus has been reached on the appropriate mosaics of habitat types and land/ocean use) through a process of equitable, inclusive and gender-responsive dialogue on where ecosystem restoration will be undertaken.
Forge and maintain partnerships and networks amongst the wide range of organisations required in a large-scale ecosystem restoration in an inclusive and gender-responsive manner.
Mediate conflicts between stakeholder groups with differing goals and objectives relating to land, freshwater and marine resource use.
Apply the principles of free, prior and informed consent in dialogues with stakeholder groups with conflicting interests.

Package and disseminate technical information on ecosystem restoration for diverse audiences including *inter alia* natural-resource policymakers, managers of ecosystem restoration initiatives, marginalised groups (e.g. women, girls and indigenous peoples) and technicians in technical departments across governments, international and regional organisations, bilateral and multilateral development cooperation agencies and NGOs.
Economists, entrepreneurs and finance experts who have the capacity to:
Quantify the economic incentives that influence how society uses ecosystems.
Quantify the full suite of costs, benefits and trade-offs of large-scale ecosystem restoration.
Manage commonly encountered cross-sectoral trade-offs (relating to *inter alia* job creation, income generation, quantity and quality of water generated in catchments, carbon sequestration, agricultural productivity, human health and biodiversity) of restoring ecosystems versus other methods of using ecosystems.
Develop bankable business plans for gender-responsive enterprises that use natural resources sustainably harvested from restored ecosystems and provide meaningful benefits to marginalised groups living in the ecosystems (e.g. indigenous peoples and local communities).
Strengthen community-based organisations, local producer organisations, local administrations and small- and medium-sized enterprises to engage in large-scale ecosystem restoration initiatives, including managing conflicts over the use of ecosystems and land tenure.
Strengthen and/or establish value chains (e.g. high-quality seeds of native flora, timber and non-timber forest products) to sustain ecosystem restoration initiatives and to ensure equitable access to markets for local communities engaged in ecosystem restoration.
Structure funding mechanisms, ranging from seed capital funds to micro-credit, to catalyse ecosystem restoration.
Enhance access to finance for marginalised groups such as women, girls, indigenous peoples and local communities that often do not have the credit history or collateral required by commercial banks or microfinance institutions.
Scientists and technology experts who have the capacity to:
Quantify the socio-economic and biophysical impacts of degradation. This includes developing an understanding of: the links between the health of ecosystems and the supply of goods/services to communities in rural as well as urban environments; how social behaviours affect ecosystem use; how marginalised groups such as women, girls and indigenous peoples are affected by degradation and how their limited access to education affects their natural resource use; and how tenure systems affect natural resource use.
Identify and address the cross-sectoral factors that caused or are still causing degradation of the ecosystem being restored.
Fully consider and incorporate the voices and aspirations of marginalised groups such as women, youth, the elderly and indigenous Peoples in the design of ecosystem restoration initiatives.
Develop ecosystem-specific protocols of ecosystem restoration that detail how local fauna and flora will play a role in the ecosystem restoration process. This includes: analysing successes and failures of past restoration efforts; using the appropriate genetic diversity of fauna and flora; setting appropriate goals for restoration; monitoring and evaluation restoration initiatives; conducting long-term research to hone restoration protocols; and managing future climate change impacts.
Develop monitoring and evaluation systems (including goals) that are affordable for local stakeholders and are able to quantify granular changes in ecosystem structure and function through time as the ecosystem is restored.
Integrate science, indigenous knowledge and traditional practices within restoration initiatives effectively.
Engage with technology companies to develop platforms and applications that will catalyse large-scale ecosystem restoration.
Integrate consistent standards of ecosystem restoration across existing ecosystem restoration initiatives.

38. *Unequal access to capital and finance*. A wide range of inequalities relating to wealth and land ownership constrain large-scale restoration globally. Insufficient capacities in the enabling environment, organisations and individuals make this particular barrier a considerable challenge. For example, restoration of degraded ecosystems often requires capital investments, reduced short-term returns from the ecosystem and a period of several years before returns on the restoration investment are realised. Access to finance and secure land tenure are consequently critical for making such commitments to restoration. Such requirements often prevent poor communities and marginalised groups (e.g. women, youth, local communities and indigenous peoples) from making the long-term decisions and investments associated with restoration. The COVID-19 pandemic and climate change are intensifying inequalities in wealth and land ownership, exacerbating this major barrier to restoration.

39. *Burden of poverty*. There are many other ways in which the burden of poverty, particularly for women and girls, greatly constrains restoration. Restricted access to education, economic opportunities and resources (e.g. land, inheritance, credit and agricultural support services) prevents poor communities from developing the skillsets, having sufficient time available, and accumulating the necessary financial resources to implement restoration. For many such communities reducing the use of natural resources to a sustainable level is not feasible because their food security and/or livelihoods would be threatened.

40. *Rights of indigenous peoples*. Inequalities faced by indigenous peoples are another major challenge for upscaling of restoration globally. Decisions on land use have in many landscapes marginalised indigenous peoples and local communities, without recognising their: i) collective rights to land and resources customarily owned or

used; ii) their systems for robust, inclusive discussion and decision-makings; and iii) their considerable capability and knowledge with regards to sustainable natural resource use and ecosystem restoration.

41. *The scientific platform.* The applied science of restoration ecology is a relatively new academic discipline that advances by analysing datasets collected over decades from plot-scale ecosystem restoration experiments. The long-term nature of the research, the paucity of large-scale ecosystem restoration experiments, and the inherent complexity of ecosystems means that knowledge on how to undertake large-scale ecosystem restoration is generated slowly. The science is further disadvantaged by being relatively poorly funded, with minimal investment into research and development taking place to hone methods of large-scale ecosystem restoration and to maximise the benefits for society in the long-term. As a result of the above factors there are often gaps in technical knowledge that constrain the upscaling of ecosystem restoration globally.

42. The context-specific nature of ecosystem restoration. Knowledge gaps are particularly apparent at a local level with regards to how to design, implement and sustain large-scale ecosystem restoration over time. This is because the approach to ecosystem restoration needs to be tailor-made to fit the unique socio-economic and biophysical conditions of any particular ecosystem. Generic protocols and approaches provide useful templates for ecosystem restoration practitioners, but experts from across numerous disciplines are invariably required to provide highly specific technical knowledge for the local context.

43. *Countering extreme degradation*. In certain environments, the state of degradation is so extreme that restoration options are greatly constrained. Examples of such environments include highly polluted sites, mine sites where topsoil has been lost, and landscapes where extinctions of flora and/or fauna occurred.

44. *Setting goals and mitigating unintended negative consequences*. It is difficult to model what the impacts of a wide array of interventions – such as policy reform, tax incentives, changes in zoning laws, shifts in subsidies, increased availability of funding for large-scale ecosystem restoration, calls for changes in consumption patterns, cross-cutting capacity development, and increased availability of tools for ecosystem restoration – will be at local, national and global scales. As a result, it is challenging to set realistic goals for all these scales and to mitigate unintended negative impacts. An example of the complexity involved is the need to model how changes in diets from animal-based to plant-based globally may improve the state of ecosystems, alter income streams for rural livestock farmers, affect national economies and affect the health of local communities unable to obtain sufficient nutrition through plant-based diets.

45. *An understanding of what past ecosystems yielded for society*. The manner in which degradation over decades or even centuries reduced the carrying capacity of a particular ecosystem, in terms of natural resources such as fruits, fodder, fish, timber, medicines, honey and fibre, is often not recorded. Other services provided by the ecosystem such as provision of high-quality water in aquifers and streams or pollination of crops are also often not documented. Societies living within that ecosystem, whether it be in an urban or rural setting, have long since adjusted to a new normal of the ecosystem not only producing a fraction of what it used to yield per hectare for earlier generations, but also now possibly exposing people to pollution and in many cases a greater density of disease vectors. It is consequently often difficult for people to envisage what healthy ecosystem can provide in terms of sustainable yields of natural resources and reduced environment-related health problems. Such benefits have usually not been quantified or deliberated on by decision-makers because it requires extensive work and collaboration from a highly skilled multi-disciplinary team of experts to model the effects of large-scale ecosystem restoration in any particular degraded ecosystem.

46. *Uncertainties in both costs and benefits*. The short-term benefits of degradation are often given greater prominence in decision-making processes than the likely long-term benefits of ecosystem restoration. This tends to be because the short-term benefits and capital costs of activities that ultimately degrade an ecosystem are easier to quantify than both the long-term benefits and the short-term capital costs of ecosystem restoration activities. The long-term negative effects of the degradation are also often difficult to quantify and therefore tend to be heavily discounted in the decision-making processes of how to use ecosystems.