

Livelihoods-based restoration of inland aquatic ecosystems for poverty reduction, food and nutrition security and biodiversity conservation

Guidance for policymakers and practitioners on putting livelihoods first in ecosystem restoration

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PREPARATION OF THIS DOCUMENT

The preparation of this document involved several stages and was led by a core group composed by experts from Michigan State University and the Food and Agriculture Organization of the United Nations.

The initial stage involved the compilation and review of a wide range of scholarly articles, and grey literature pertinent to the subject matter. Additionally, valuable insights were gleaned through interviews with experts with practical experience implementing ecosystem restoration in developing countries to gather diverse perspectives and stay abreast of the latest developments in the field. Following the synthesis of research findings and expert inputs, the initial draft of the document was developed.

The draft underwent thorough scrutiny and refinement through a series of reviews and feedback discussions during an international workshop convened at Michigan State University for this purpose. The diverse expertise and perspectives brought forth during these sessions were invaluable in enhancing the document's comprehensiveness and robustness.

Based on the feedback received during the workshop, the document underwent comprehensive revisions under the joint leadership of Dr. David Coates and Dr. Abigail Bennett to address comments, incorporate additional insights, and further strengthen the content's quality and relevance.

Finally, the document the text was edited in line with FAO style by Evan Jeffries, and layout and formatting were handled by Sierra Jezuit, ensuring that the document's visual presentation is both appealing and accessible.

ABSTRACT

Two important imbalances in the dialogue on ecosystem restoration are addressed. First, the over-focus on ecological objectives as the entry point. Second, the underrecognition of the importance of and opportunities for restoration of inland aquatic ecosystems. Most current general forums, literature and guidelines on ecosystem restoration emphasize ecological approaches and/or outcomes for nature. Human well-being, and more rarely livelihoods benefits, are often implied but not always central. The approach here does so, adopting a people-centred approach that addresses the objectives of livelihoods, poverty reduction and food and nutrition security. Ecological outcomes are seen as a tool to achieve this end and co-benefit of it. The approach significantly changes how ecosystem restoration is assessed, planned, implemented, monitored, and funded, trade-offs among winners and losers become more transparent and central, local knowledge is prioritized over scientific/technical approaches and local communities are placed central to the design and implementation of interventions. Apart from human rights, justice and equity considerations and alignment with development goals and priorities, a peoplecentred approach with a focus on livelihoods, poverty and food security is more likely to deliver sustainable outcomes, including for biodiversity, particularly where local communities are empowered to manage the direct use of these ecosystems for livelihoods benefits. The guidance provides only a brief introduction to the topic through a set of principles, relevant conceptual frameworks, a theory of change and key considerations in designing an ecosystem restoration programme or project. The intention is, where necessary, to shift the policy approach and how practitioners use associated guidance on relevant topics. Throughout, examples from inland aquatic ecosystems in developing countries are provided to illustrate the topics.

CONTENTS

Abs	tract tributor	of this document	iii iv viii ix	
1	INTRO	DDUCTION	1	
1.1	Why tl	ne attention to ecosystem restoration?	1	
1.2	Why ti	ne emphasis on livelihoods <i>versus</i> ecological/environmental goals?	1	
1.3	Why a	n emphasis to restore inland aquatic ecosystems?	6	
1.4	4 What is "restoration" and the required end point			
1.5	The sp	pecific livelihoods focus of this guidance	10	
1.6	Existin	ng relevant general guidance on ecosystem restoration	11	
2.	KEY APPROACHES AND CONSIDERATIONS FOR ECOSYSTEM RESTORATION IN INLAND AQUATIC ECOSYSTEMS FOR LIVELIHOODS			
2.1	Princi	oles and approaches	14	
	2.1.1	Principles	14	
	2.1.2	Adopt a strategic approach	15	
	2.1.3	Precautionary approach	16	
2.2	Conce	ptual frameworks	16	
	2.2.1	Ecosystem services, livelihoods, and inland aquatic ecosystems	16	
2.3		ceptual framework for designing restoration of inland aquatic ecosystems elihoods	20	
	2.3.1	Using a theory of change to design interventions	21	
2.4	Key co	onsiderations	22	
	2.4.1	Restoration is a process not an event	23	
	2.4.2	Target those degraded ecosystems that deliver the greatest potential for livelihoods benefits from restoration	23	
	2.4.3	Co-design and co-implement solutions with local communities	23	
	2.4.4	The importance of livelihoods-based indicators	26	
	2.4.5	Clearly establish and verify the problem at the outset	33	
	2.4.6	Justice, equity, rights, tenure and stewardship	34	
	2.4.7	Identifying ecosystem services	37	
	2.4.8	Trade-offs and Synergies	40	
	2.4.9	Addressing drivers of ecosystem degradation	48	
		Accounting for biodiversity	51	
		Accounting for "ecosystem functions"	52	
		Building sustainability The analysis any iron ment	53 54	
		The enabling environment	54	
		Defining the scope and scale of the restoration Financing restoration	57 58	
DE	EDEN	256	61	

Figures

1.	Conceptualisation of the direction of travel of an ecology/environment versus a livelihoods prioritized approach to restoration of inland aquatic ecosystems for livelihoods, poverty reduction and food and nutrition security	4
2.	An overview of the general approaches and key considerations involved in livelihoods-based restoration of inland aquatic ecosystems outlined in subsequent sections	
3.	Highly simplified linkages between the natural world (life on earth/biodiversity), ecosystem services and human well-being	
4.	An ecosystems services and poverty alleviation (ESPA) conceptual framework as of 2009	19
5.	A conceptual framework for inland aquatic ecosystem restoration for livelihoods	20
6.	A simple decision tree for determining livelihoods issues/deficits in an area and the scope for ecosystem restoration solutions	33
7.	(a) Cross-scale connections linking the Lake Chilwa wetland (inner circle), the practices in the catchment (intermediate circle) and threats (outer circle) to the wetland; (b) the major wetland components (inner circle) and the main livelihoods activities that are practised in each of these (outer circles)	41
8.	Example of a balance sheet approach to trade-off and synergy assessment for restoration of inland aquatic ecosystems	45
9.	Examples of linkages between policies for interventions in restoration for inland aquatic ecosystems for livelihoods and broader domains and their policies, strategies and regulations	57
Tal 1.	Examples of some relevant dimensions of livelihoods-based indicators for restoration of inland aquatic ecosystems for livelihoods and poverty reduction	28
Bo	xes	
1.	The human and poverty context of Target 2 of the Kunming-Montreal Global Biodiversity Framework	2
2.	What is a livelihood?	2
3.	Examples of the contribution of inland aquatic ecosystems to local livelihoods and food and nutrition security	8
4.	Eight principles for the restoration of inland aquatic ecosystems for livelihoods	15
5.	Ecosystem services from inland aquatic ecosystems	18
6.	Participatory design of restoration of mangroves leads to more effective and sustainable outcomes	24
7.	Indigenous Peoples	26

8.	Local communities view "ecosystem health" in livelihoods related terms	30
9.	Linking livelihoods outcomes and restoration interventions –inequitable distribution of benefits in Chilika Lagoon, India, and the need for adaptive management	32
10.	Pathways to enhance gender equality and women's empowerment in inland aquatic food systems	35
11.	Demonstrating local knowledge and capacity to manage sustainably helps promote a human rights based approach to mangrove restoration in Costa Rica Change in governance of tenure of mangroves driven by livelihoods-based community restoration efforts	36
12.	Sources of guidance on the economic valuation of ecosystem services	39
13.	Adding post-harvest value succeeds in improving the status of mollusc gathering women in mangroves in Costa Rica	40
14.	Examples of synergies across multiple policy areas for inland aquatic ecosystems	44
15.	Examples of synergies across multiple policy areas for inland aquatic ecosystems	46
16.	Mapping stakeholder interests and power	47
17.	Addressing the right drivers is key to mangrove restoration	49
18.	Government policies as a driver of degradation and enabler of restoration of inland aquatic ecosystems – the case of rice paddy production	49
19.	Examples of livelihoods and biodiversity co-benefits	52
20.	Climate change adaptation in the Mekong Delta	54
21.	Enabling conditions for supporting mangrove restoration	55
22.	Carbon markets as a source of funding for restoration of inland aquatic ecosystems for livelihoods	60

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PREFACE

This document addresses two important imbalances in the dialogue on ecosystem restoration: the over-focus on ecological objectives and the under-recognition of the importance of inland aquatic ecosystems. The emphasis within most current forums, literature and guidelines on ecosystem restoration puts ecological objectives and nature conservation as the primary objective and entry point for designing interventions. In some cases, "human wellbeing" is implied with limited, if any, clarification of what the term means, nor which humans are to benefit and how. If livelihoods are mentioned it is usually secondary and, in many cases, they are seen as a threat to restoration not the objective of it. The paradigm change proposed here is to people-centred, putting humans first, through the lens of "livelihoods", with ecological outcomes seen as a tool to achieve this: hence, nature conservation, or improved "ecosystem condition", becomes the co-benefit. The shift in focus is much more than semantic. Changing the perspective alters the approach to restoration, how it is assessed, implemented, monitored, and funded. Trade-offs among winners and losers become more transparent and central, local knowledge is prioritized over scientific/technical approaches and local communities are placed central to the design and implementation of interventions. Not only is the approach more consistent with pro-poor and equitable objectives but a focus on livelihoods is also more likely to deliver sustainable outcomes, including for biodiversity, particularly where local communities are empowered to manage the direct use of these ecosystems for livelihoods and food security benefits.

The approach is not universally applicable to all inland aquatic ecosystems. It is most applicable to those inland aquatic systems where there remains a very close and direct dependency of local communities on them for their livelihoods, poverty alleviation and food and nutrition security. This level of dependency has now largely disappeared from developed regions, but not entirely.

Inland aquatic ecosystems are among the most valuable and biodiverse but suffer the highest level of loss and degradation and fastest rate of biodiversity loss of all ecosystem types (IPBES, 2019). The level of direct dependency of people on them can be very high (Funge-Smith and Bennett, 2019). This report focuses particularly on the role of these systems in poverty reduction and food and nutrition security. The importance of these ecosystems for achieving the social, economic and

environmental dimensions of the sustainable development goals is underrecognized, including in the 2030 Agenda itself (Elliott *et al.*, 2022). Consequently, there is a need to address the imbalance in attention to these systems to reduce deficits in both pro-poor and inter-dependent biodiversity conservation benefits from ecosystem restoration.

The scope of "inland aquatic ecosystem" in this document

The geographic scope of an "inland aquatic ecosystem" in this document includes those that occur landwards of the boundary between the sea and land; that is, landwards of the "shoreline". This interpretation includes areas adjacent to marine seas that can be also classified as "coastal", for example, mangroves. Inland seas include, for example, the Caspian Sea. These aquatic ecosystems are predominantly freshwater but can also include brackish water (e.g. estuaries, tidal zones, brackish seas) and be transiently marine. Typical types include lakes, floodplains, swamps, lagoons, rivers, and streams but also artificial ecosystems such as reservoirs or other constructed wetlands and highly managed aquatic ecosystems such as areas of rice cultivation. Officially these are all classified as "wetlands" but usage of the term varies among groups¹.

The boundaries of individual inland aquatic ecosystems are difficult to define and can change (e.g. seasonally). Terrestrial and aquatic components of the landscape are inter-connected as are inland and coastal areas of seas. Dependencies can be local, regional, or even global; for example, larger systems can influence regional climates and wetland-dependent migratory species can move inter-continentally. Understanding the intimate links between livelihoods and inland aquatic ecosystems requires a consideration of all relevant ecological processes or influences and not just those in their immediate vicinity.

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¹ The UN Convention on Biological Diversity has officially adopted the definition of wetlands in use by the Ramsar Convention on Wetlands: "areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres" (Article 1.1 of the convention) and "may incorporate riparian and coastal zones adjacent to the wetlands, and islands or bodies of marine water deeper than six metres at low tide lying within the wetlands" (Article 2.1). This covers all inland and most coastal aquatic systems, including rivers, lakes, and artificial water bodies (e.g. reservoirs, rice paddies). However, this definition is not universally used.

Goal and intended audience

This guidance is intended for policymakers, funding agencies, scientists and those practicing restoration activities. The goal is to raise awareness by providing a brief overview of the main considerations necessary to achieve more equitable and sustainable inland aquatic ecosystem restoration, with particular emphasis on how the livelihoods lens affects approaches taken for design, resource allocation, implementation, and assessment.

The ecological, economic, and social settings of restoration, and options for restoration measures, vary greatly. There is no one-size-fits-all approach to restoration. Restoration design needs to be tailor-made to fit the sites, ecology and local communities involved – as done with all sensible rural development / conservation efforts. This guidance is not a stepwise manual for how to undertake restoration in practice. Those involved in or embarking on restoration will avail themselves of more detailed guidance available from many other formal and informal sources. Here, the intention is to influence how such guidance is approached and adopted.

1 INTRODUCTION

1.1 Why the attention to ecosystem restoration?

The status and trends in the Earth's ecosystems, and the resulting impact on human wellbeing (e.g. IPBES, 2019) led to the establishment of *The United Nations Decade on Ecosystem Restoration* (2021–2030)², co-led by the Food and Agriculture Organization of the United Nations (FAO) and the United Nations Environment Programme (UNEP). The Kunming-Montreal Global Biodiversity Framework, adopted at the fifteenth meeting of the Conference of the Parties to the Convention on Biological Diversity in 2022³, includes the ambitious global target to ensure that by 2030 at least 30 percent of areas of degraded ecosystems are under effective restoration.

1.2 Why the emphasis on livelihoods *versus* ecological/environmental goals?

The two main reasons for an emphasis on livelihoods objectives are: (i) consistency with sustainable development goals, and (ii) to increase the prospects for sustained benefits from restoration. The Kunming-Montreal Global Biodiversity Framework (GBF) and the Principles of the Rio Declaration require a focus on livelihoods (Box 1), cognisant of justice, societal equity, and poverty alleviation outcomes. In addition, many restoration efforts have failed because of inadequate attention to livelihoods needs, limited consideration of human-environment trade-offs, inequitable distribution of benefits and costs, limited or ineffective engagement with decision makers and planners, poor science and a focus on unsustainable short-term actions (IUCN, 2021). The evidence also shows that the most successful examples of restoration of inland aquatic ecosystems in developing countries are those based on livelihoods objectives and led by local communities and these also deliver biodiversity conservation co-benefits (Coates, 2023). National programmes focused on livelihoods security also can be a major source of funding for ecosystem restoration (e.g. Lengefeld et al., 2022), and a lack of recognition of this can result in missed opportunities to promote ecosystem restoration through the improved management of the productive sectors and to engage and encourage the full range of community across multi-purpose landscapes to further the aims of the GBF.

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² United Nations General Assembly Resolution A/RES/73/284; 01 March 2019.

³ CBD Decision 15/4.

Box 1. The human and poverty context of Target 2 of the Kunming-Montreal Global Biodiversity Framework

Target 2 of the Framework is 'Ensure that by 2030 at least 30 percent of areas of degraded terrestrial, inland water, and coastal and marine ecosystems are under effective restoration, in order to enhance biodiversity and ecosystem functions and services, ecological integrity and connectivity'. However, the Framework is to be consistent with the 2030 Agenda for Sustainable Development and the Sustainable Development Goals (Decision 15/4 Annex para. 3) and the Principles of the Rio Declaration^a (Decision 15/4 Annex Section C para. 7(k)): Principle 1 reinforces the centrality of humans ('Human beings are at the centre of concerns for sustainable development. They are entitled to a healthy and productive life in harmony with nature') and Principle 5 highlights the essential task of eradicating poverty ('All States and all people shall cooperate in the essential task of eradicating poverty as an indispensable requirement for sustainable development, in order to decrease the disparities in standards of living and better meet the needs of the majority of the people of the world'). The topic is also relevant to defining and identifying areas of "high biodiversity importance" or similar terms throughout the Framework.

The term "livelihood" can have multiple meanings according to stakeholder and audience. Here a holistic view is taken to its meaning (**Box 2**).

Box 2. What is a livelihood?

The term "livelihoods" has various meanings. It can, for example, mean 'the way someone earns he money people need to pay for food, a place to live, clothing, etc.' (Cambridge Dictionary) that can be the prevailing understanding among development practitioners. This focus on earning money distorts the reality of livelihoods that are much more complex and include, for example, those that do not buy their food but grow, forage or catch it, and the importance of various livelihoods assets and strategies during times of vulnerability and stress. Here a much broader definition is used - 'the capabilities, assets (stores, resources, claims and access) and activities required for a means of living' (Chambers and Conway, 1992). The second definition reflects the fact that key target groups do not necessarily rely on money as the main means to achieve their living. A sustainable livelihood is one that is resilient and can cope with and recover from stress and shocks, maintain, or enhance its capabilities and assets, and provide equivalent livelihoods opportunities for the next generation, and which contributes net benefits to other livelihoods at the local and global levels and in the short and long term (Knutsson, 2006). Because inland aquatic ecosystems support services that underpin all other social and economic dependencies, most notably through water regulation, in principle these systems can directly or indirectly support or influence options for the availability of all livelihoods in a particular area and often even beyond it (e.g. dependent communities downstream).

Sources: Chambers, R. and Conway, G. 1992. Sustainable rural livelihoods: practical concepts for the 21st century. Institute of Development Studies (UK). https://opendocs.ids.ac.uk/ndownloader/files/48232906. Knutsson, P. 2006. The sustainable livelihoods approach: A framework for knowledge integration assessment. Human ecology review, 13(1), 90–99. https://humanecologyreview.org/pastissues/her131/knutsson.pdf

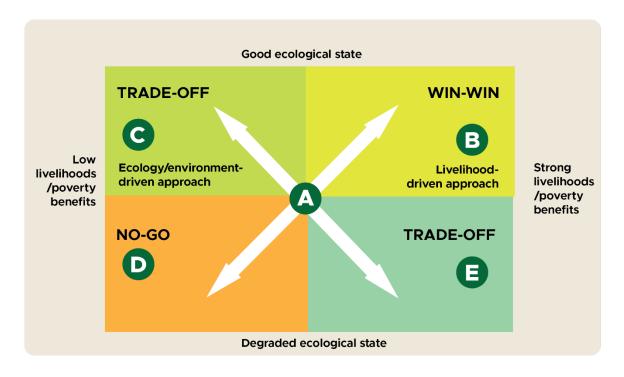
^a Rio Declaration on Environment and Development (A/CONF.151/26/Rev.l (vol.I)), United Nations publication, Sales No. E.93.1.8.

Much of the public information, literature, guidance, and attention to ecosystem restoration focusses on ecological or environmental objectives and outcomes (for example, INBO/GWP, 2015; Speed *et al.*, 2016; FAO, IUCN CEM and SER, 2021; Cooke *et al.*, 2022; SER, 2022; Beeston *et al.*, 2023). Some of these vaguely imply that economic and social co-benefits are delivered. Often "human wellbeing" is claimed as an outcome but in this context is a vague term since everybody has a "human wellbeing" whether rich or poor or food secure or insecure. Some include limited attention to "livelihoods" but often depict use of biodiversity as a threat to biodiversity and a driver of ecosystem degradation. Hence livelihood issues are often considered secondary, or worse, a negative pressure on the objectives of ecosystem restoration.

Although improvements in ecosystems might benefit people, whether implied or not, this is often not proven, quantified, used as a measure of the impact of restoration, or used as a basis of project design or site selection. It is also not always clear that ecosystem restoration leads to improved human welfare. Outcomes depend on the objectives and the appropriateness of the measures undertaken. For example, an attempt to restore "back to nature" a degraded ecosystem that is heavily used by local communities can, and most likely would, result in their disenfranchisement from benefits currently received and likely exacerbate poverty, or lead to the failure of the restoration effort itself. Additionally, inappropriate forms of restoration can have negative environmental and social consequences (for example, Parr, Te Beest and Stevens, 2024).

To illustrate the difference between the prioritisation of livelihoods versus ecology/environment based ecosystem restoration, a simplified conceptualisation of the direction of travel for each approach is provided in **Figure 1**. Where ecological objectives are prioritized, the direction is to head from point A in direction C (**Figure 1**). This will promote a good ecological state but likely diminish livelihoods/poverty outcomes. Where livelihoods are prioritized, the travel is point A to direction B – where livelihoods/poverty outcomes and ecological state are optimized. Moving from A in direction E represents increasing livelihoods/poverty benefits but at the expense of further degradation. Moving from A in direction D represents increasing degradation and decreasing livelihood/poverty benefits and is the most undesirable direction (no go). A direction E and A direction D probably most

Figure 1. Conceptualisation of the direction of travel of an ecology/environment versus a livelihoods prioritized approach to restoration of inland aquatic ecosystems for livelihoods, poverty reduction and food and nutrition security



Note: "A" is the starting point—the arrows represent chosen directions of travel from the starting point. Source: Adapted from Kumar, R., Horwitz, P., Milton, G.R., Sellamuttu, S.S., Buckton, S.T., Davidson, N.C., Pattnaik, A.K., Zavagli, M. and Baker, C. 2011. Assessing wetland ecosystem services and poverty interlinkages: a general framework and case study. Hydrological Sciences Journal, 56(8), 1602–1621. http://dx.doi.org/10.1080/02626667.2011.631496.

closely reflect the historical trajectory of development and environment with varying degrees of unsustainability. In reality, of course, not all the relationships are linear, as each is context specific and likely more complex in practice than depicted in this theoretical figure. But the point is that outcomes depend on the direction of travel or the objective, adopted at the outset, with direction A to B representing greatest coherence between both livelihoods/poverty and environment/ conservation goals. In addition, as noted already, moving from A in direction B is also the most likely to result in a sustainable improved ecological state because the local community motivation for restoration will usually be livelihoods based.

This report highlights how a people-centred approach significantly changes how restoration is planned, funded, and monitored. The prioritisation of engagement with people results in greater inclusion of relevant stakeholders on the issues at hand. Additionally, trade-offs become much more explicit and central to project design, and

the approach requires primarily livelihoods/poverty-based indicators (see Section 2.3.3).

A people-centred approach also influences site selection decisions, and prioritisation of sites for restoration. An easy way to meet the goal of 30 percent of degraded area restored by 2030 (Target 2 of the GBF) would be to restore ecosystems with lower levels of human use whereas a human-centred approach may better identify heavily-utilized landscapes that are more suitable for restoration from a livelihoods/poverty perspective. The most compatible approach to support sustainable development and human welfare is to work where population density and resource dependency is heaviest (maximum social impact). This report argues that a priority is to make progress on these sites, using these guidelines, and redirecting funding to that end.

However, the approach promoted here recognizes that there are cases where "biodiversity" objectives can be more prominent, such as, for example, regarding degraded areas that support unique, critical and highly threatened species and/or ecosystems with "high biodiversity value". Even so, in most cases a people centred approach is most likely to lead to sustainable outcomes for biodiversity. But in rare cases biodiversity could be prioritized over direct benefits for local people provided that suitable and equitable compensation is inbuilt into intervention design, where required, with stakeholder participation and agreement.

Even when environmental restoration projects are designed with poverty alleviation in mind, experience shows that the losses they caused were often not always commensurate with the benefits provided at time scales relevant to ensure they gain local community support (Schleicher *et al.*, 2018). Environmental restoration initiatives often prioritize the scientific and technical aspects of restoration over other types of knowledge that contribute to successful and sustainable restoration efforts. Adopting a people centred approach makes it more likely that an understanding of local politics, land use dynamics and power relations are incorporated in the restoration design (Sandlos and Keeling, 2016). Design based on untested assumptions about local socio-ecological systems runs the risk of exacerbating local ecological and social-economic problems rather than alleviating them (Fox and Cundill, 2018). Large-scale environmental restoration initiatives that treat all stakeholders alike as opposed to recognizing that restoration activities have varied

impacts on people with different degrees of power and capital, livelihoods practices and types of attachment to the ecosystem, can result in entrenching social inequity. For example, environmental restoration projects have been recorded to more likely benefit privileged groups, such as the landowning elite, who can claim benefits or compensation for activities on their land, rather than the landless poor (Muñoz-Piña *et al.*, 2008). However, there are encouraging signs that lessons are being learned and it is hoped this report can help shift approaches further.

This document argues that a people centred approach should be explicit in ecosystem restoration initiatives and seen as a tool to achieve co-benefits for people and "nature". This is consistent with FAO's mandate, with "livelihoods" adopted as the overarching framework for poverty reduction and food and nutrition security and with the human outcomes sought within the 2030 Agenda for Sustainable Development.

Most traditional cultures and modern approaches to social-environmental systems management have a worldview that incorporates "ecological" and "human" outcomes together, regarding both as integral to societal wellbeing (e.g. IPBES, 2022). This is consistent with the approach promoted here — that people and ecosystems are interconnected and need to be considered together, but with people as the entry point for objectives when designing interventions.

1.3 Why an emphasis to restore inland aquatic ecosystems?

Inland aquatic ecosystems are by far the most valuable type of ecosystem in terms of social and economic benefits to people (Russi *et al.*, 2013). The economic use value of water alone from freshwater ecosystems in 2021 was estimated at approximately USD 58 trillion, equivalent to 60 percent of global GDP (WWF, 2023). This includes a total quantifiable direct use value of a minimum of USD 7.5 trillion and an additional USD 50 trillion annually, seven times more, from the indirect benefits that are currently chronically undervalued in policies.

The values of inland aquatic ecosystems in supporting local livelihoods and their role in food and nutrition security varies widely but locally and regionally can be significant and under recognized (**Box 3**). These systems are also highly biodiverse and under the greatest threats to that biodiversity (IPBES, 2019). Despite this, they have suffered a much greater level of loss of extent (variously estimated to be up to 85 percent since the 1700's) and degradation than any other ecosystem type and

are currently experiencing the fastest decline; for example, three times the rate of loss of forests (Davidson, 2014; IPBES, 2019; Fluet-Chouinard *et al.*, 2023). Losses in overall ecosystem services4 from wetlands between 1997 and 2011, due to changes in their extent alone, were valued at USD 7.2 trillion per year only for tidal marshes and mangroves and USD 2.7 trillion just for floodplains (Costanza *et al.*, 2014). But these global economic value estimates, although striking, can disguise increases in impoverishment including losses in livelihoods and food and nutrition security that can arguably, in cases, be characterized as infinite. Losses in benefits due to degradation, as opposed to loss of area, including for managed or artificial systems, has not been adequately assessed but is likely also substantial. Ecosystem loss and degradation can also result in enormous social and economic losses (Russi *et al.*, 2013). The high levels of dependency of many local communities, and in many cases regional or national economies, on these ecosystems for their livelihoods and food and nutrition security calls for them to be prioritized for restoration efforts (Coates, 2023).

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⁴ There are alternative value systems for ecosystems including 'nature's benefits to people' as an alternative to "ecosystem services" and alternative belief systems such as 'Mother Earth' (IPBES, 2019) that are recognized throughout this guidance.

Box 3. Examples of the contribution of inland aquatic ecosystems to local livelihoods and food and nutrition security

Inland fisheries can be a major component of livelihoods for communities dependent on inland aquatic ecosystems and have consistently been missing from important discourses, such as their contribution to local, regional and national food and nutrition security and livelihoods (Welcomme *et al.*, 2010; Harper *et al.*, 2013; Lynch *et al.*, 2017; Funge-Smith and Bennett, 2019; Bennett *et al.*, 2021). For example, in the lower Mekong River Basin, most households rely on capture fisheries for food and nutrition security and over 50 percent of households rely on capture fisheries as a significant part of their livelihoods strategy (MRC, 2023).

Value and supply chains, comprising networks of actors and their activities that deliver products and services, amplify the role capture fisheries (and other natural resources) play (Bennett *et al.*, 2022; FAO *et al.*, 2023). There is often limited understanding of the value, contribution and dependency of women in inland fisheries that can be very high (Harper *et al.*, 2020; Cole *et al.*, 2020; Lawless *et al.*, 2021; FAO, 2023). Pandemics such as the COVID-2019 have demonstrated the vulnerability of livelihoods-based on inland fisheries (Béné, 2020; Belton *et al.*, 2021; Sunny *et al.*, 2021) as well as highlighting their importance as safety nets when markets collapse.

Ecosystem loss and degradation are the major threats to sustaining most major inland fisheries (Welcomme *et al.*, 2010; Funge-Smith, 2018). Major opportunities for ecosystem restoration were therefore identified, for example, by Coates (2023).

Rice is among the top staple foods in the world. Rice paddies are classified as a major wetland type and are critical to many developing countries due to the linkages between food security, human health, poverty reduction, biodiversity, livelihoods and sustainable wetland management^a. For example, in Cambodia, rice field fisheries that strongly rely upon natural processes persist in up to 80 percent of rice farmland (Freed *et al.*, 2020), whereas their degradation due to unsustainable intensification can lead to loss of food and nutrition security, livelihoods and biodiversity and continued expansion of rice growing areas into more natural wetland areas further diminishes local native fisheries.

Mangroves directly support the livelihoods, food security and well-being of hundreds of millions of people as well as sequestering and storing large quantities of carbon, regulating water quality, and protecting the coast. Over the last five decades, 20 –35 percent of mangroves have disappeared and of the 1 100 000 hectares lost since 1996, around 818 300 ha of mangroves are considered "restorable" (Beeston *et al.*, 2023).

Sources: See References.

^a Conference of the Parties to the Convention on Wetlands (Ramsar, Iran, 1971) Resolution XI.15.

1.4 What is "restoration" and the required end point

Ecosystem restoration encompasses a range of practices and goals, which can vary with local conditions and societal choice (UNEP, 2021). Based on an ecological perspective, there is a continuum of restoration actions and outcomes (Gann *et al.*, 2019):

 Reducing degrading impacts – transforming economies and production systems toward sustainable use, such as reducing pollution;

- ii. Remediation bio-physical manipulation to reinstate basic ecological functions such as hydrology regimes;
- iii. Rehabilitation the progressive repairing and enhancement of function and integrity to increase ecosystem service flows; and
- iv. Ecological restoration representing the highest ecological ambition,
 ultimately with specific native biodiversity goals referencing a benchmark.

Adding the livelihoods perspective to this continuum results in, for example, to:

- i. move the system towards increasing and sustaining livelihoods by Reducing degrading impacts;
- ii. beginning to Remediate, or reinstate, livelihoods through ecological
 Remediation that reinstates basic ecological functions;
- iii. the progressive **Rehabilitation**, or repairing and enhancement of livelihoods through ecological **Rehabilitation** that progressively repairs and enhances the function and integrity to increase ecosystem service flows; and
- iv. the ultimate end point of **Ecological restoration** (with locally relevant biodiversity goals against a referenced benchmark) is unlikely to be a goal that can be sustained unless that end is, or was previously, achieved or considered achievable whilst recognizing the need for sustainable use of biodiversity (for example, as happens with some forms of agricultural biodiversity that is sustained by traditional farming).

The important point for current purposes is that the intended livelihoods outcome becomes a critical element in determining the ecological interventions undertaken, and not *vice-versa*.

In this guidance the term "restoration" applies to any ecosystem type. Notably, it can apply to highly modified, managed, or artificial ecosystems where their functions are delivering sub-optimal outcomes for people and biodiversity, including where the objective of restoration is to maintain the ecosystem in its managed state; for example, rehabilitating ecological functions to improve overall ecosystem service delivery and livelihoods in rice-paddy fields, reservoirs or artificial peri-urban wetlands (examples are provided later).

Restoration is a form of nature-based solution defined as 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, resilience, and biodiversity benefits' (UNEA, 2022).

1.5 The specific livelihoods focus of this guidance

The focus of the current guidance is livelihoods that depend on the use of biodiversity in inland aquatic ecosystems, and principally their provisioning services. This includes value chain benefits arising from harvest and post-harvest activities (such as value added through processing and marketing). The indirect reliance on biodiversity value chains can also have important gender considerations.

These are essentially livelihoods-based on:

- Food, including from:
 - o fisheries;
 - hunting and gathering including plants and non-timber forest resources from wetland dependent habitats; and
 - agricultural production (including both crops and livestock) where products are from aquatic systems (e.g. rice paddies) or are directly dependent on them (e.g. water use for vegetable cropping from dry season shallow water ponds, seasonal floodplain grazing or duck ponds).

Raw materials including:

- wetland dependent fibres;
- o wetland dependent timber; and
- aquatic medicinal and other genetic resources where benefits arise locally.

There are other livelihoods relevant ecosystem services in play. Examples include livelihoods-based on recreational fisheries and tourism. Water regulation is a highly valuable service of wetlands including for local communities as well as those distant from a particular site. There are also ecosystem services that underpin resilience, notably to variations in climate and climate change, that are also highly relevant to

sustaining livelihoods; for example, nature-based solutions for flood risk adaptation can involve wetland conservation or restoration that would also support sustainable fisheries (WWAP and UN-Water, 2018). Because ecosystem services can be highly inter-dependent, and therefore so can livelihoods dependent upon them, restoration efforts should as far as feasible identify and consider all potential ecosystem services and livelihoods in play and potential trade-offs between or synergies among them. This includes dependencies beyond the immediate target area.

1.6 Existing relevant general guidance on ecosystem restoration

There is much existing guidance relevant to ecosystem restoration. These are valuable sources of guidance in specific areas, most often on ecological restoration. The level of attention to, or incorporation of, livelihoods into these varies considerably, most give only cursory attention. The purpose of the current document is to address this shortcoming and promote awareness of the need to explicitly consider livelihoods where necessary. Examples of existing guidance include: developing a roadmap for Kunming-Montreal Global Biodiversity Framework Target 2 (FAO, 2023); the UNEP and FAO strategy for the Decade on Ecosystem Restoration (UNEP and FAO, 2020); international principles and standards for ecosystem restoration (Gann et al., 2019); principles and guidance adopted by the Convention on Biological Diversity for the ecosystem approach (CBD, 2004) and ecosystem-based management (CBD, 2018); forest landscape restoration (Bessau et al., 2018; César et al., 2021); guidance on wetland restoration (Ramsar Convention, 2002); nature-based solutions (IUCN, 2016; Cohen-Shacham et al., 2019); ecosystem and sustainability approaches for agriculture (Abdelmagied and Mpheshea, 2020; FAO, 2014, 2018); the ecosystem approach to fisheries, that includes people as part of the ecosystem (Garcia et al., 2003); and best practice guidelines for mangrove restoration (Beston et al., 2023). The ten steps to responsible inland fisheries (MSU and FAO, 2016) cut across themes of correct valuation of inland fisheries, engagement of stakeholders, and crosscutting issues of how to incorporate aquaculture and consider other important inland fisheries accords and principles, including the Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries in the Context of Food Security and Poverty Eradication (FAO, 2015). Garcia et al. (2018) and Garcia and Ye (2018) presented approaches for rebuilding fisheries, noting fish are important keystone species for ecosystem

function, the greatest biomass of vertebrate life on the planet and an important carbon engineer.

There is also much guidance available on sustainable livelihoods approaches that put people and their everyday livelihoods at the heart of decision-making (Rigg, 2007; Scoones, 2009). These approaches draw across important concepts, including vulnerability and shocks, power and the institutional process determining access to resources, and well-being (Belton, 2016; de Haan and Zoomers, 2005; Hapke and Ayyankeril, 2004; White, 2010). Further, the approaches highlight the importance of understanding the temporality of livelihoods and how people interact with resources at different times (Dijk, 2011; Valbuena *et al.*, 2015). These approaches have the potential to examine complex relationships of ecosystem restoration in inland aquatic systems for livelihoods bringing to the fore important issues such as the agency of different stakeholders, trajectories of benefits realized from ecosystems, and perceived impacts of ecosystem restoration on people's well-being. A well tried and tested sustainable livelihoods framework is that of DFID (1999), still in widespread use. Extensive guidance on the relationships between ecosystem services and poverty reduction is available (e.g. Schreckenberg, Mace and Poudyal, 2018).

2. KEY APPROACHES AND CONSIDERATIONS FOR ECOSYSTEM RESTORATION IN INLAND AQUATIC ECOSYSTEMS FOR LIVELIHOODS

In the following guidance, interrelated general approaches (principles, conceptual frameworks, theory of change) and key considerations provide guidance on a livelihoods-based approach to the restoration of inland aquatic ecosystems. These are not set in sequence but are to be considered together. Users are urged to draw the relationships across these as they generate context specific restoration activities. An overview of the following sections is provided in **Figure 2**.

Figure 2. An overview of the general approaches and key considerations involved in livelihoods-based restoration of inland aquatic ecosystems outlined in subsequent sections

Cross-cutting considerations • Co-design and co-implement solutions with local communities • The importance of livelihoods-based indicators General approaches Clearly establish and verify the problem at the Principles and outset • Justice, equity, rights, tenure and stewardship approaches Identifying and valuing ecosystem services Conceptual Trade-offs and synergies frameworks Addressing drivers of ecosystem degradation Theory of change Accounting for biodiversity Building sustainability • The enabling environment • Defining the scope and scale of restoration Financing

Ecosystems are complex with multiple interactions across scales of space and time. It can be difficult to predict the consequences of actions across scales and sectors (DeFries and Nagendra, 2017). Even well-intentioned and scientifically well-designed interventions for ecosystem services can fail the poorest, most vulnerable, and powerless, leading to a bad situation persisting or worsening with poverty traps being one consequence (e.g. Dawson, Coolsaet, and Martin, 2018; Martin *et al.*, 2018). These complexities obviously raise a cautionary note when designing interventions. But the complex science involved also supports a key tenet of this document that the importance and value of local and traditional knowledge should be well recognized and the primary source of information, at least at smaller (local) scales. Interventions led and implemented by local communities, based on their knowledge, are at the forefront of many local successes in improving livelihoods outcomes of restoration of inland aquatic ecosystems (Coates, 2003). A key approach, therefore, is for government administrations to formally recognize this role of local communities and empower them to undertake restoration.

The approach and priority considerations depend on scale. This report focuses mainly on local scale interventions where local communities hold most of the relevant knowledge and will be the key implementers of restoration initiatives. This is the scale at which most successes are occurring and where livelihoods aspects are clearly identifiable in practice (Coates, 2023). Restoration of inland aquatic ecosystems can also occur at larger catchment scales where more "scientific" approaches, usually undertaken by those not directly dependent on the ecosystem, can be more prominent. But there is also a risk that different understandings of the environment and ecological processes can lead to different interventions that can conflict. A key need when linking across scales is to ensure that outcomes for livelihoods, poverty reduction, food and nutrition security are prioritized, affected communities have full and effective participation in design and that interventions are based on relevant indicators.

Usually, a multi-scale approach will be needed. Local development plans often need the technical and legal support of district governance at the wider district scale, and legal, hydrology/river basin and development plans in support at the broader provincial scale. Often, in crowded lowland landscapes, communities cannot do this on their own without the wider scale layers of support from district, provincial and national government.

2.1 Principles and approaches

2.1.1 Principles

Some key principles for using livelihoods as the framework for restoration of inland aquatic systems are highlighted in **Box 4**.

Box 4. Eight principles for the restoration of inland aquatic ecosystems for livelihoods

- Put people at the heart.
 - Benefits for local communities should determine objectives and strategies.
 - o People should be involved at all stages of planning, design and implementation.
- Prioritize poverty alleviation.
 - o Recognize that poverty is complex and multi-dimensional.
- Empower communities to undertake change.
 - Experience shows that successful restoration is achieved where local people are at the forefront of implementation, but they often need enabling.
 - o Benefits to communities drive community efforts for restoration.
- Emphasize food and nutrition security.
 - o Inland aquatic systems can be critical for food and nutrition security.
 - o Food and nutrition security is an important dimension of poverty and wellbeing.
- Make the invisible visible.
 - Identify and make visible:
 - Hidden values of the benefits of inland aquatic ecosystems.
 - The poorest and most vulnerable groups and how they can benefit.
- Aim for justice and equity.
 - Justice and equity:
 - Require recognition of the status and rights of various stakeholders and their power in decision making.
 - Influence the procedure adopted including full and effective participation in setting objectives and outcomes.
 - Impact the distribution of benefits.
- Focus on social and societal change.
 - o Social behaviours drive ecosystem degradation and restoration.
 - o Restoring ecosystems is about behavioural change.
- Addressing drivers of change is key to restoration outcomes.
 - The indirect and direct drivers cause degradation. Identifying and reversing these is essential to identify interventions and sustain outcomes.
- Ecological outcomes are a tool to achieve wellbeing objectives
 - Ecological (including biodiversity) outcomes both support and are a co-benefit of sustainable wellbeing.
 - Sustainable use is key to sustaining biodiversity and ecological health.

2.1.2 Adopt a strategic approach

The dynamic and complex nature of inland aquatic systems, their interdependencies with catchments and their socio-economic relationships mean that narrowly-focused

restoration actions that fail to consider their externalities and unintended consequences should be avoided. Generally, a more strategic approach entails:

- a systems-based approach, recognizing hydrological, physical, socioeconomic, political and cultural aspects of the interconnections between ecological and human systems;
- a need for better planning for ecosystem restoration that recognizes the need for balancing trade-offs between different outcomes and interests; and
- an adaptive management and learning-by-doing adaptive learning approach, that continuously assesses assumptions, trends and outcomes with regards to objectives and allows for adjustments to goals and interventions over time.

Restoration strategies should identify and respond to the linkages between external and internal direct and indirect drivers of ecosystem degradation, hydrological and ecological processes, ecological health, the provision of ecosystem services (and to whom), livelihoods dependency on those services, and societal objectives.

2.1.3 Precautionary approach

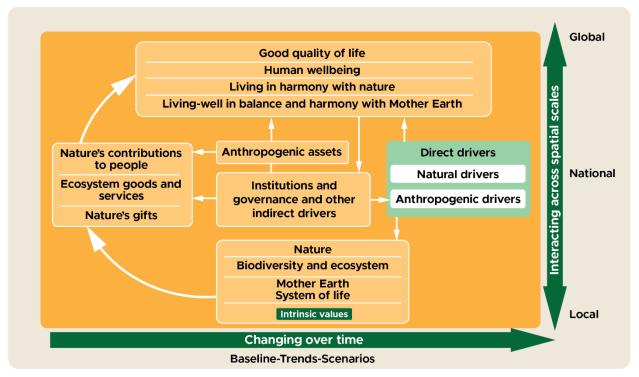
The precautionary principle should apply throughout; that is, where a significant risk or detrimental situation is perceived, the absence of, or weaknesses in, scientific and other data should not delay or constrain the adoption of measures to restore.

2.2 Conceptual frameworks

2.2.1 Ecosystem services, livelihoods, and inland aquatic ecosystems

Ecosystem services are the benefits provided by ecosystems to people and the link between biodiversity and human well-being (**Figure 3**). An ecosystems services approach or framework is therefore the most appropriate technical/scientific entry point for assessments. However, the level of detail involved will vary according to circumstance. An introduction to an ecosystem services framework is provided for example by Kasparinskis et al. (2018). However, careful and disaggregated analysis is required if livelihoods and poverty reduction linkages are to be properly identified.

Figure 3. Highly simplified linkages between the natural world (life on earth/biodiversity), ecosystem services and human well-being



Source: Adapted from Díaz, S., Demissew, S., Carabias, J., Joly, C., Lonsdale, M., Ash, N., Larigauderie, A. et al. 2015. The IPBES Conceptual Framework - connecting nature and people. Current Opinion in Environmental Sustainability 14, 1-16. https://doi.org/10.1016/j.cosust.2014.11.002 under https://creativecommons.org/licenses/by-nc-sa/3.0/

For example, Daw et al. (2011) noted: different groups derive well-being benefits from different services, creating winners and losers as they change; dynamic mechanisms of access determine who can benefit; an individuals' contexts and needs determine how services contribute to well-being; and, aggregated analyses may neglect crucial poverty alleviation mechanisms such as cash-based livelihoods. These factors present challenges in data availability and selection of how and at which scales to disaggregate.

2.2.1.1 Ecosystem services and livelihoods targeted in this guidance

Inland aquatic ecosystems deliver a very wide range of ecosystem services and there are differing ways of classifying this. An example is provided in **Box 5**. The level, values, and other importance of each of these services vary considerably between locations, and according to ecological, hydrological, social, economic, and demographic factors, among others. Ecosystem services are often grouped into "bundles" which deliver a range of services together in the same place. Many services, or bundles, are inter-dependent and management actions to alter one

invariably have impacts on others. For example, as a generality, unsustainable development has tended to maximize provisioning services (goods) at the expense of the regulating, habitat, and cultural services whereas sustainable development aims to optimize ecosystem services delivery across all services (IPBES, 2019).

Box 5. Ecosystem services from inland aquatic ecosystems

The categorisation of these services can differ somewhat among authors and sources. They may include but are not limited to the following services:

Provisioning services

- 1 Fooda
- 2 Water
- 3 Raw materials
- 4 Genetic resources
- 5 Medicinal resources
- 6 Ornamental resources

Regulating services

- 7 Air quality regulation
- 8 Climate regulation
- 9 Disturbance moderation
- 10 Regulation of waterflows
- 11 Waste treatment
- 12 Erosion prevention
- 13 Nutrient cycling
- 14 Pollination
- 15 Biological control

Habitat services

- 16 Nursery service
- 17 Genetic diversity
- 18 Biodiversity
- 19 Habitat

Cultural services

- 20 Aesthetic value
- 21 Recreation
- 22 Inspiration
- 23 Spiritual experience
- 24 Cognitive development

Sources: Modified from De Groot, R., Brander, L., Van Der Ploeg, S., Costanza, R., Bernard, F., Braat, L., Christie, M. et al. 2012. Global estimates of the value of ecosystems and their services in monetary units. Ecosystem Services, 1(1), 50–61. https://doi.org/10.1016/j.ecoser.2012.07.005. Bennett, A., Patil, P., Kleisner, K., Rader, D., Virdin, J. and Basurto, X. 2018. Contribution of fisheries to food and nutrition security: Current knowledge, policy, and research. NI Report 18–02. Durham, NC, Duke University.

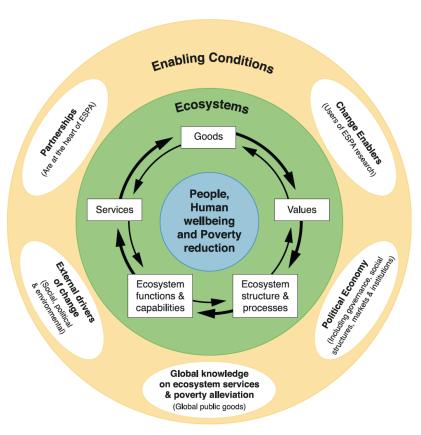
https://nicholasinstitute.duke.edu/sites/default/files/publications/contribution of fisheries to food and nutrition security 0.pdf

^a The "food" benefits provided by ecosystems also include nutritional aspects of the food provided. This is a very important dimension of ecosystem services provided by inland ecosystems, particularly regarding the products of fisheries. For example, the nutritional value of products from inland fisheries, such as quality of protein, fats, and micronutrients, can be extremely high and outstrip their values calculated simply based on volume of catch or even amount of dietary energy (Bennett *et al.*, 2018). These benefits also include those attained through added value through the marketing chain – for example benefits accrued through processing, marketing, and increasing sale income.

2.2.1.2 Ecosystem services and poverty alleviation frameworks

There has been much research on the relationship between ecosystems and poverty alleviation and/or human wellbeing, including the evolution of various conceptual frameworks. Many of these are complex and unhelpful for non-specialists. An earlier more simplified example is provided in **Figure 4** as a basis for introducing the topic. The importance of enabling conditions is highlighted (the outer circle in **Figure 4**). Examples provided below include the role of gender empowerment in restoration (**Box 15**), the importance of strengthening governance and tenure of resources (**Box 11**), addressing the correct drivers of mangrove degradation (**Box 21**) and the importance of government policies as drivers of degradation and restoration (**Box 18**).

Figure 4. An ecosystems services and poverty alleviation (ESPA) conceptual framework as of 2009



Source: Schreckenberg, K., Mace, G. and Poudyal, M. (Eds.). 2018. Ecosystem Services and Poverty Alleviation: Trade-offs and Governance. Routledge, New York and London. https://doi.org/10.4324/9780429507090, Creative Commons Attribution-Non Commercial-No Derivatives 3.0 license.

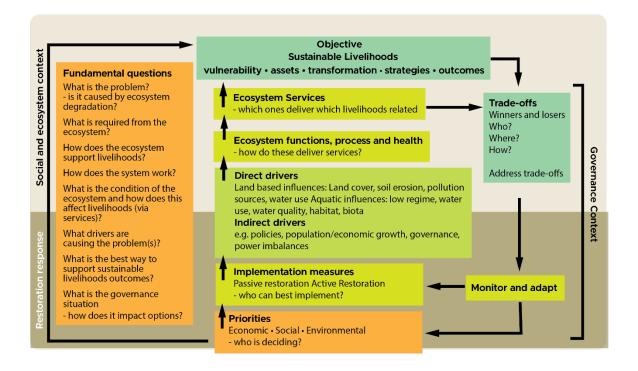
2.3 A conceptual framework for designing restoration of inland aquatic ecosystems for livelihoods

A simplified conceptual framework for designing inland aquatic ecosystem restoration for livelihoods is presented in **Figure 5**. The framework highlights, among other points, that:

- The objective/outcome is livelihoods
- Priority setting is key
 - But more importantly who is setting the priorities?
- Livelihoods are supported through ecosystem services
- Restoration is about addressing first the drivers of loss of ecosystem services (ecosystem degradation), then later implementing direct restoration interventions
- Trade-offs are critical
- Governance is the cross-cutting issue

Various aspects of the framework are covered in further detail in the sections that follow.

Figure 5. A conceptual framework for inland aquatic ecosystem restoration for livelihoods



2.3.1 Using a theory of change to design interventions

The optional use of a theory of change (TOC), whether used as a starting point or as the backbone of detailed planning and implementation, can be very useful to help clarify what the problem is, the best opportunities to address it and how to monitor progress, as fundamental aspects of a successful approach. A key feature is the clear articulation of the current state (and the reasons for it), the future state required (the change to be achieved) and the identification of interventions required to achieve that state through analysis of causal links. Adopting an adaptive management approach to the project cycle helps avoid a too linear approach. The key difference between a livelihoods approach and an ecology-based approach to a TOC for restoration is that change (the objective) is defined in livelihoods (and related socioeconomic) terms, with monitoring and indicators being livelihoods based. Ecological aspects would still be important, included and monitored, but as causative links between current status and the change required.

The approach is widely used in project development and design. It is often required by donors but has usefulness well-beyond this. Much supporting guidance is available, some of which was used as the basis for this section⁵. A stepwise approach is often used comprising:

- Step 1: Focus. Identifying the change required, where, for whom and the timescale.
- Step 2: Change Analysis. What is needed for the change to happen. Involving identification of the immediate, underlying, root/structural problems (somewhat comparable to identifying drivers), and a "problem tree" that is converted to the appropriate "solution tree".
- Step 3: Making assumptions and risks explicit. Including causality (what leads to what and how), implementation (how proposed actions are designed and targeted to deliver results), external factors (assumptions about the influence

21

⁵ For example: https://analysisfunction.civilservice.gov.uk/policy-store/the-analysis-function-theory-of-change-toolkit/#resources-to-help-you-understand-the-relevance-of-toc; and https://unsdg.un.org/sites/default/files/UNDG-UNDAF-Companion-Pieces-7-Theory-of-Change.pdf

of issues outside the area of work that can facilitate or hinder the expected change), risks (environmental, social, political, and from project design).

Step 4: Identify partners and key actors.

A TOC model will result in, among other benefits:

- an agreement amongst stakeholders about how they define success, what data should be collected, and when and how to measure success;
- a clear process to draw on existing research, theory and knowledge about how change works in specific contexts;
- a plan for monitoring and evaluation to help identify the most useful lines of enquiries, understand what works, and learn from failures;
- a visual representation of the change wanted;
- a powerful communication tool that captures the complex processes involved;
 and
- helping funders understand how working with you will help them achieve their own objectives.

A full-blown TOC is normally accompanied with a logical framework or similar that tabulates the change (objective), intermediate states, outcomes, outputs required to achieve them (interventions/actions), inputs (resources required), implementation mechanisms and budgets. Such details are beyond the scope of the current document.

2.4 Key considerations

The 15 concepts outlined in this section provide livelihoods focused considerations that should be applied across the processes of ecosystem restoration. We emphasize here that these considerations are not stepwise processes, but rather represent important issues that collectively nudge restoration activities towards a "people centred" process. Across the considerations, we offer either relevant examples across the world, frameworks or conceptualizations that demonstrate the applicability of them.

2.4.1 Restoration is a process not an event

Restoration requires long-term planning, inputs, monitoring and evaluation:

- Sustainability of restoration outcomes should be in-built from the start:
 - Short-term interventions are unlikely to succeed;
 - Particular attention should be given to creating an enabling environment that supports longer-term outcomes;
 - Ecological, social, economic and political influences will change over time. This will affect the restoration outcomes; and
 - Hence monitoring and evaluation need to be sustained and adaptive management implemented.

2.4.2 Target those degraded ecosystems that deliver the greatest potential for livelihoods benefits from restoration

A people-centred approach to ecosystem restoration that explicitly addresses livelihoods provides the opportunity to target those degraded ecosystems that can potentially deliver the highest level of livelihoods opportunities and benefits from restoration interventions. As argued in these guidelines, this will also, in most cases, deliver ecosystem/biodiversity conservation co-benefits since the two are interdependent. Targeting those degraded ecosystems that have lower levels of direct dependency (e.g. lower population densities, for example "wilderness") might offer greater opportunity for achieving the area based Target 2 of the Kunming-Montreal Global Biodiversity Framework but with more limited progress towards the Sustainable Development Goals collectively.

2.4.3 Co-design and co-implement solutions with local communities

The existence of high levels of livelihoods dependency directly on inland aquatic ecosystems is widespread and often a distinguishing feature of many rural and periurban communities in developing countries. This is a significant difference to most developed countries – except for some indigenous communities there. Those that depend directly on the services of local inland ecosystems are the holders of the most relevant and valuable information on the ecosystems and the livelihood needs and priorities of the communities. These communities are often the best knowledge holders for what the issues and opportunities are and how to address them. Many of the best examples of successful, and cost-effective, ecosystem restoration are those

Box 6. Participatory design of restoration of mangroves leads to more effective and sustainable outcomes

Spatially-explicit social data are rarely systematically integrated into ecosystem conservation and restoration management planning in data-poor developing states. Two participatory approaches (public participation in geographic information systems and concept modelling workshops) were used to investigate the dynamics and spatial distribution of the mangrove resources in use by local communities in Madagascar. Each community proposed mangrove zoning consisting of strict conservation zones, sustainable use zones and restoration zones. Following validation and ground-truthing, the proposed zones and management strategies formed the basis of the zoning and management plan. Participatory approaches proved a simple and reliable way to gather spatial data and better understand the relationships between the mangrove and those who use it. Moreover, participation stimulated mangrove users to consider resource trends, the impacts of their activities, and required management actions, promoting a collective "buy-in" for the project. Since participation extended beyond research to the development of management zones, rules and strategies, community ownership of the project was strengthened and the chances of successfully conserving and improving the mangrove improved.

Sources: Rakotomahazo, C., Aigrette Ravaoarinorotsihoarana, L., Randrianandrasaziky, D., Glass, L., Gough, C., Todinanahary, G.G.B. and Gardner, C.J. 2019. Participatory planning of a community-based payments for ecosystem services initiative in Madagascar's mangroves. Ocean & Coastal Management, 175, 2019, 43–52. https://doi.org/10.1016/j.ocecoaman.2019.03.014.

initiated, led and managed by local communities. These communities provide a significant resource, both in terms of knowledge and a workforce, to implement cost-effective restoration measures. Local communities are not only those most directly affected by inland water ecosystem degradation, they also hold knowledge about conditions in the past, causes of degradation and solutions as well as being the quickest responders to local events (**Box 6**).

In all cases, the full and effective participation of local affected communities, and their knowledge provided under free and prior informed consent, should be at the forefront of identifying livelihoods issues, potential links to ecosystem degradation and the potential for ecosystem restoration-based solutions. The participatory design of interventions that a people-centred approach represents is key to success (e.g. Coates, 2023; Kura *et al.*, 2023).

- Local communities should:
 - have full and effective participation in all aspects of project planning from the start:
 - o be a primary source of information including on:
 - the extent and values of ecosystem services in play;
 - the problems in play, their drivers and root causes;
 - workable solutions;
 - be central to project implementation including undertaking relevant restoration measures; and
 - be an integral part of project monitoring, evaluation, and adaptive management.
- Who's knowledge is used and how is critical. Prioritize local community knowledge as a very diverse (not monolithic) body of information, especially for livelihoods, including for the identification and implementation of restoration measures:
 - o local knowledge should not be incidental;
 - additional sources of knowledge (e.g. scientific knowledge), "external" to the local community can be a useful complementary source of guidance and inputs. Access to case studies and experience from elsewhere can be valuable. Such sources often become more relevant at larger scales, for example regarding catchment scale processes or higher-level sociopolitical aspects of governance that can be beyond the scope of local knowledge; and
 - whatever knowledge is used it needs to be relevant, practical, useful and fit-for-purpose.

"Communities" are not homogenous, and their engagement should include representation from all groups including by ethnicity, age, gender, occupation, status, wealth/ownership, power, among other factors. Additional considerations can apply in the case where the local population ("local community") are Indigenous Peoples (**Box 7**).

Box 7. Indigenous Peoples

The United Nations Declaration on the Rights of Indigenous Peoples assigns certain rights, including, among many others, the right to self-determination, autonomy and self-governance, protection from any action which has the aim or effect of dispossessing them of their lands, territories, or resources. Indigenous peoples often do not regard themselves as "stakeholders" but as "rights holders". In the current context, in principle, this means that indigenous peoples have rights to be protected from ecosystem degradation in the first place, and rights over how any restoration is undertaken. But in practice things can be considerably different.

There are also requirements regarding the use of "indigenous knowledge" that requires free prior and informed consent (FPIC) for its use. However, this report promotes approaches where knowledge holders are central to formulating plans and decision making and, therefore, use the knowledge themselves. Use of that knowledge by others requires FPIC.

Justice and equity would logically require the similar principles and approaches should be applied to local communities and local knowledge holders, whether indigenous or not.

This report prescribes that matters relating to Indigenous Peoples are considered and appropriate approaches are applied throughout, as applicable. Further guidance is provided, for example, by FAO (2016).

Sources: FAO. 2016. Free Prior and Informed Consent. An indigenous peoples' right and a good practice for local communities. A manual for practitioners. Rome: FAO. https://openknowledge.fao.org/handle/20.500.14283/i6190e.

Guidance on undertaking rural appraisal with the participation of local communities are widely available, such as that provided by the FAO⁶.

2.4.4 The importance of livelihoods-based indicators

Clearly the Vision, Goals and Targets for restoration need to be livelihoods focussed. But the indicators used is one of the clearest defining features of whether a programme, project or guidance takes a people-centred approach. Typically, restoration interventions based on ecological approaches focus on measurements of ecological state (e.g. ecosystem extent, condition and health) often with secondary livelihoods indicators, if at all. A people centred approach designs and measures interventions based on livelihood indicators.

The identification of relevant and appropriate indicators is one of the most important steps in designing interventions. Indicators are not just a means of monitoring progress towards an outcome or target, they are a primary means of indicating, and

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⁶ https://www.fao.org/4/x5996e/x5996e06.htm#6.%20PRA%20Tool%20Box

verifying, what the target or outcome is. Hence, they provide a check that the outcome or target is what was intended. Identifying and defining indicators is, therefore, an active process as part of project/intervention design, not a passive response to pre-determined outcomes/targets. Identifying indicators can be a useful pre-cursor to identifying outcomes. Monitoring should provide evidence-based outcomes of restoration in livelihoods terms, using defined goals and targets and appropriate, livelihoods based, indicators.

There is much general and specific guidance available for livelihoods-based indicators and metrics; examples, among many, include Pasteur (2014), UK Aidmatch (2023) and Livelihood Centre (2023). Special attention needs to be given to relevant food and nutrition aspects of sustainable livelihoods and poverty including the dimensions of availability, access, utilisation and stability (comprehensive guidance available through the FAO⁷), particularly for women (FAO *et al.*, 2023) and relevant food security coping strategies (e.g. WFP, 2023). Manikas, Ali and Sundarakani (2023) provide a review of various methodologies in use. An example of methodologies for a sustainable livelihoods approach to identifying and monitoring relevant trends in poverty and livelihoods in small scale fishing communities is provided by Venkatesh (2006). Evaluating the monitoring results enables adaptive management to take place that increases the likelihood of longer-term and sustained impact.

An example of the scope of some relevant livelihoods-based indicators is provided in **Table 1**. In all cases, special attention needs to be given to disaggregating indicators by geography/livelihood zone; gender, age, disabilities, chronic diseases (for individuals, associations members, etc.); head of household's gender, age, disabilities, chronic diseases, dependency ratio (for households), and any other relevant criteria, such as urban/rural context, religious, ethnic or political identities; wealth groups; livelihood group (e.g. pastoralist, farmers, traders); period to achieve the objective.

⁷ E.g. https://www.fao.org/common-pages/search/en/?q=food+security+and+nutrition+measurement+

Table 1. Examples of some relevant dimensions of livelihoods-based indicators for restoration of inland aquatic ecosystems for livelihoods and poverty reduction

Key livelihood area

Example indicators

1. Achieving survival and/or livelihood protection threshold

- 1.1. Number/percentage of target households [have enough <food, cash, incomes> to] meet their survival threshold
- 1.2. Number/percentage of target households [have enough <food, cash, incomes> to] meet their livelihood protection threshold
- 1.4. Number/percentage of target households reduce their [damaging] coping strategies compared with pre-restoration, post disaster level, or baseline level, last year -same period-, normal year>

Note: Enough food includes food of sufficient nutritional quality and dimensions of food security (including sustained access, availability and utilisation).

2. Ownership of, and access to, productive assets

- 2.2. Number/percentage of target population <nouseholds, productive organisations, MSME> have enough productive assets (specify the type of asset if necessary) to <restore, recover, strengthen> their livelihoods

Note: Productive assets include natural capital – that is the relevant "ecosystem" including its extent, health, functioning and accessibility to it. Physical productive assets (physical infrastructure) are particularly relevant where it improves the delivery, availability, sustainability or access to natural capital.

3. Productivity enhancement

- 3.1. Number/percentage of target population <nouseholds, productive organisations, MSME> improve their production by (specify how much) [specify type of production if necessary], [due to <restoration, new practices, new technology, training, etc.>]
- 3.2. Number/percentage of target population <nouseholds, productive organisations, MSME> reduce their production losses by (specify how much) [specify type of production if necessary], [resulting from restoration or use of improved practices (specify practices)]

4. Increase and/or diversification of incomes

- 4.1. Number/percentage of target population <nouseholds, productive organisations, MSME> <stabilize, improve> their net income by (specify the improvement), [due to (specify if necessary the livelihood activities and the cause of improvement)]
- 4.2. Number/percentage of target population <households, productive organisations, MSME> diversify (quantify if necessary) their income generation activities (specify source/s if necessary) [increasing their net income by (specify the improvement)]
- 4.3. Number/percentage of target population employed or self-employed in sustainable livelihood activities (specify if necessary)
- 4.4. Number/percentage of sustainable micro, small and medium enterprises (MSME) initiatives (specify if necessary) <created, strengthened> [achieve (specify the goal, e.g. business objectives, number of clients)] due to the intervention

5. Access to livelihood support services and markets

- 5.1. Number/percentage of target population <nouseholds, productive organisations, MSME> gain improved access to livelihood support services, markets> (specify if necessary) due to programme intervention
- 5.2. Change in target < livelihood support service initiatives (specify), markets > provided or strengthened (specify if necessary) through programme intervention

6. Resilience, disaster risk reduction and natural resources management

- 6.1. Number/percentage of target population <noseholds, communities, productive organisations, MSME> applying or receiving key <resilience, disaster risk reduction, natural resource management, climate change adaptation> practices or benefits (specify if necessary) to <strengthen, protect> their livelihoods
- 6.2. Number/percentage of target natural resources (specify) under improved natural resource management (specify)
- 6.3. Number/percentage of productive assets/infrastructures/natural capital (specify) protected (specify how, if necessary) to future hazards (specify if necessary)

7. Livelihood rights, policies and regulations improvement

- 7.1. Number/percentage of target population (specify group) with <access to, equal opportunities in> developing their livelihood activities (specify if necessary) through programme intervention
- 7.2. Change in new <policies, laws, contingency plans, strategies, structures> adopted (or created) to improve the livelihood development and protection environment (specify if necessary) for (specify target group)

Source: Adapted from Livelihood Centre. 2023. Livelihood Indicators Guide.

 $https://www.livelihoodscentre.org/documents/114097690/114438854/LRC. + Livelihoods+Indicators+Guide+vMar2016_EN. pdf/38595574-86cc-10fc-6ab3-$

a9bfbf204989?t=1569397356722#:~:text=The%20objective%20of%20this%20guide,of%20the%20impact%20of%20their (Accessed 20 December 2023).

Only "headline" indicators are provided to illustrate scope. Definitions and units of measurement are not included. In all examples, the indicator must include causal links, that is, the change must be linked to the reason why it occurred (whether due to the intervention made).

MSME: micro, small and medium enterprises (formal or informal). The Survival Threshold represents the total income required to cover 100 percent of minimum food energy needs (2 100 kcal per person per day), plus the costs associated with food preparation and consumption (i.e. salt, soap, kerosene and/or firewood for cooking and basic lighting), plus any expenditure on water for human consumption. The livelihood protection threshold represents the total income required to sustain local livelihoods. This means total expenditure to: (a) Ensure basic survival, plus (b) maintain access to basic services (e.g. routine medical and schooling expenses), plus (c) sustain livelihoods in the medium to longer term (e.g. regular purchases of seeds fertilizer, veterinary drugs, etc.), plus (d) achieve a minimum locally acceptable standard of living (e.g. purchase of basic clothing, education, coffee/tea, etc.).

The above indicators are to be supplemented by indicators of ecological function, state and "health". Examples of these are widely available and often dominate ecosystem restoration literature and as such are not listed further here. Ecological indicators remain important and primarily serve to identify and monitor causal links between interventions and livelihoods-based outcomes as well as monitoring ecological co-benefits. As illustrated in **Figure 1**, outcomes need to involve a positive shift in both livelihoods and ecological state.

For ecological indicators priority should be given to the use of Local Ecological Knowledge as part of the participatory design of projects (Grimm, Spalding and Leal, 2024). It is highly pertinent to the approach promoted in these guidelines that local communities often perceive the ecological/environmental "health" of local ecosystems primarily in livelihoods terms (**Box 8**).

Those affected by restoration initiatives should be central to determining indicators and to monitoring and evaluation through their full and effective participation in planning and implementation. Belcher *et al.* (2013) provides a case study of a community led process to identify sustainable livelihoods relevant indicators that undertook several participatory processes in each village to engage community members in discussions about current conditions, trends and likely implications, and

Box 8. Local communities view "ecosystem health" in livelihoods related terms

Mangrove conservation and restoration requires understanding of the health of the ecosystem. But "ecosystem health" is defined differently across users due to differences in knowledge of the ecosystem, scales of the ecosystem being assessed, perceptions of what is "healthy", or because of differences in the way people use or benefit from ecosystems. A case study of a mangrove fishing community in coastal Thailand examined how local people assess and define mangrove ecosystem health primarily through livelihood related concepts. Mangrove ecosystem health is defined by the communities through both direct material benefits derived from the ecosystem, non-material aspects, and the relational value experienced through "bundles" of benefits linked to people's livelihood activities. The findings support the approach promoted in these guidelines by illustrating that ecosystem health frameworks would be more useful if they incorporated social components and metrics, recognizing both the interdependencies between ecosystems and human societies, and that ecosystems possess intrinsic value. Local communities that interact most closely with ecosystems can contribute to improving and operationalising frameworks for ecosystem health.

Sources: Elwin, A., Robinson, E.J., Feola, G., Jintana, V. and Clark, J. 2024. How is mangrove ecosystem health defined? A local community perspective from coastal Thailand. Ocean & Coastal Management, 251, p.107037. https://doi.org/10.1016/j.ocecoaman.2024.107037

about their own expectations, aspirations and concerns, specifically: participatory mapping; focus group discussions; multidisciplinary landscape assessment; visioning exercises; and, participatory photography workshops.

Monitoring and indicators need to consider the temporality and interdependencies of livelihood activities and options. Inland aquatic ecosystems are usually highly seasonal, supporting varying livelihoods over the annual cycle. Clearly, livelihoods options will change (positively or negatively) according to local socio-economic conditions and opportunities for alternative livelihoods. Livelihoods can also shift among the options based on the use of living aquatic resources from inland aquatic ecosystems. For example, aquaculture development on floodplains in Bangladesh can provide complementary livelihoods support to predominantly capture fishery-based livelihoods strategies, including increasing benefits from the capture fishery (Haque and Day, 2017). As a result of ecosystem restoration of that ecosystem, fisher communities stopped waterbird hunting and shifted to ecotourism, increasing their income 2.5 times in the last two decades (Kumar *et al.*, 2016).

Plans, strategies, and interventions should be continually revised according to feedback from trends in indicators through adaptive management (**Figure 5**). Vigilance to cater for unforeseen events or outcomes is essential (**Box 9**).

Box 9. Linking livelihoods outcomes and restoration interventions – inequitable distribution of benefits in Chilika Lagoon, India, and the need for adaptive management

Livelihood outcomes of restoration efforts for inland aquatic ecosystems need to be well understood and closely monitored to be able to identify causal pathways between restoration and poverty reduction. Identifying drivers of trends is critical to an adaptive management approach.

Chilika Lagoon (India) suffered severe degradation resulting in increased poverty. The lake is now widely cited as an example of successful restoration delivering both biodiversity and livelihoods benefits and has received multiple prestigious awards. Ecological restoration brought life back in Chilika Lagoon, the livelihoods base of 200 000 fishers and 400 000 farmers. It has also improved habitat quality of this Ramsar Site, including a million wintering migratory waterbirds and a healthy population of Irrawaddy Dolphins (Kumar et al., 2016).

However, initial significant increases in lake productivity were not leading to commensurate improvements in the livelihoods of local fishers (as one stakeholder group among many). A significant proportion of the fishing population comprises small-scale fishermen and many studies illustrate that these people are exploited by middlemen in the process of fish marketing combined with money lending (Iwasaki and Shaw, 2008). This negative dependency gives rise to poverty and triggers indiscriminate fishing that threatens fishery resources sustainability through a fish marketing structure stemming from indebtedness and instability caused by perpetual conflicts over fishery resources. The example illustrates the importance a fish marketing structure for restoration outcomes and fishery resource conservation.

Interventions aimed at improving the distribution of benefits from Chilika fisheries by strengthening Primary Fishermen Cooperative Societies have resulted in 21 percent increase in gross value realisation by fisher households and 13 percent savings in interest outgoings on household debt (Kumar *et al.*, 2016).

Since the 1990s, India has formed numerous locally situated organisations for decentralising governance of natural resources. However, these organisations largely remain ineffective in addressing resource issues at the local scale, devolution, and participatory governance. The contemporary natural resource governance at Chilika Lagoon limits decentralisation, which in practice is a mere reduction in the scale of institutional control (Baral, 2019).

The case of the small scale fishery-based livelihoods system of Chilika Lagoon shows that the relationship between livelihoods, shocks and stresses, capitals, institutions and livelihoods strategies is circular and not linear (Nayak, 2017).

Sources: Baral, K. 2019. Revisiting Decentralising Organisations at Chilika Fishery. Social Change, 49(4), 623-642. https://doi.org/10.1177/0049085719872926

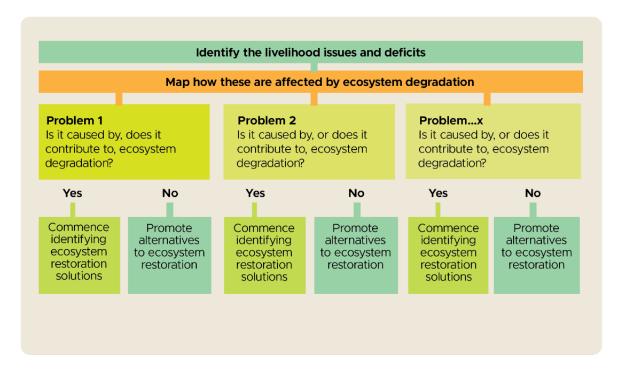
Iwasaki, S. and Shaw, R. 2008. Fishery resource management in Chilika lagoon: a study on coastal conservation in the Eastern Coast of India. *Journal of Coastal Conservation*, 12, 43–52. https://doi.org/10.1007/s11852-008-0022-y Kumar, R., Ambastha, K., Kumar, S., Chakraborty, A., Dalakoti, K. and Meetei, A.Y. 2016. *Economics of Ecosystem Services and Biodiversity for Conservation and Sustainable Management of Inland Wetlands*. The Economics of Ecosystems and Biodiversity India Initiative. GIZ India. 96 p.

Nayak, P.K. 2017. Fisher communities in transition: Understanding change from a livelihoods perspective in Chilika Lagoon, India. *Maritime Studies*, 16, 1-33. https://doi.org/10.1186/s40152-017-0067-3.

2.4.5 Clearly establish and verify the problem at the outset

False assumptions lead to failures. The starting point is to identify what the livelihoods issues, including both deficits and opportunities, are in a target area. Second, the role and contribution of ecosystem degradation and restoration should

Figure 6. A simple decision tree for determining livelihoods issues/deficits in an area and the scope for ecosystem restoration solutions



be identified. It should not be assumed that a livelihoods deficit in an area, including one based on direct exploitation of local living aquatic resources in a highly degraded area, is due to ecosystem degradation. A simple decision tree could be adopted (e.g. **Figure 6**).

Environmental degradation should not be used as the first entry point as this can lead to false assumptions. Ecological issues/criteria/factors become more relevant once potential links between livelihoods and ecosystem degradation are known. Levels of ecosystem degradation are an important means of identifying potential target areas but not necessarily degraded livelihoods.

Local affected communities, and their knowledge, should be at the forefront of identifying livelihoods issues, potential links to ecosystem degradation and the potential for ecosystem restoration-based solutions.

2.4.6 Justice, equity, rights, tenure and stewardship

Issues of justice and equity are central to how priorities and the agenda for ecosystem restoration for livelihoods in inland aquatic ecosystems are set (**Figure 5**). Direct dependency of local communities on living aquatic resources in these systems is usually closely associated with the lowest income groups and local, and often regional, food and nutrition security (Section 1.3).

Environmental justice relates to how differences in power, wealth, identity or status can limit people's just claims over environmental resources and has a central role in ecosystem services debates (Sikor, 2013, provides a useful introduction to the topic). It is a significant factor in assessing trade-offs (Section 2.3.6). Power imbalances are likely to benefit the powerful, and affluent, at a cost to the poor and powerless. The link between environmental degradation, equity and power is probably a major indirect driver of ecosystem degradation impacting livelihoods of the poor that depend on inland aquatic ecosystems. Inland aquatic ecosystems are particularly vulnerable to the external land and water use changes often driven by power imbalances. The "justice gap" needs to be closed if environmental resources are to be sustainably managed to benefit the poor (Dawson, Coolsaet, and Martin, 2018). The key steps are to recognize this issue and integrate mechanisms and processes into approaches to ensure that decisions, and outcomes, result in just and equitable distribution of benefits. Justice is more than a moral imperative, equitable governance is instrumental to achieving environmental policy goals, rather than contrary to them (Dawson, Coolsaet, and Martin, 2018; Nunan et al., 2018).

A "human rights-based approach" offers similar, but not identical, entry points for addressing justice and equity. Human rights are universal, inalienable, interdependent, indivisible, equal and non-discriminatory (UNEG, 2011). Gender, and empowerment of other under-represented groups, is an important dimension of such rights (**Box 10**). These considerations apply not only to the hunting, catching or harvesting of products from inland aquatic ecosystems but equally to processing and marketing throughout the value chain (Cole *et al.*, 2020).

Box 10. Pathways to enhance gender equality and women's empowerment in inland aquatic food systems

Addressing gender equality and women's empowerment is critical if aquatic food systems are to contribute more to improving food security, nutrition and livelihoods while reducing poverty. Based on case studies, four pathways to enhance gender equality and women's empowerment in aquatic food systems are identifiable:

- Pathway 1: Gender equity considerations must be integrated into every stage of innovation development, dissemination and uptake. This involves moving beyond male-focused innovation processes to include explicit assessments of women's needs and engage women as innovators. It is also important to consider the interests of youths and the intersectionality aspects such as wealth, education, age, caste, ethnicity and disability, among others.
- Pathway 2: Achieving inclusive livelihoods and wealth generation including economic empowerment of poor women, men and marginalized individuals in a community requires building the right enabling environment. Key enablers include supportive family relations, education and strategies to avoid further loss of assets, such as social protection, investments in social networks, and engaging women in equitable decision-making at all scales.
- Pathway 3: Inclusive governance of small-scale fisheries and aquaculture can be enhanced through gender-responsive and rights-based policies, closing the gender data gap, amplifying the voices and leadership of women and marginalized individuals, and creating strong buy-in from political leaders.
- Pathway 4: Gender-transformative approaches are needed to engage women and men in addressing underlying structural barriers in aquatic food systems, including constraining gender norms and relations.

Sources: Adam R.I., McDougall C., Bevitt K., Freed S., Gomese C., Johnson A., Lau J., Mudege N., Muzungaire L., Rajaratnam S. et al. 2021. Four pathways to achieve gender equality and women's empowerment in small-scale fisheries and aquaculture: Insights from FISH research. FISH Gender Report. Penang, Malaysia: WorldFish. Program Report: FISH-2021-28.

Rights and stewardship, over resource use and/or management, are important to securing sustainable small-scale fisheries in the context of food security and poverty eradication (FAO, 2015). The governance of tenure of fisheries and related land and forest resources is an important related need (FAO, 2022). If the relationships between user and management rights and tenure are not acknowledged and appropriately engaged restoration is likely to either result in inequitable outcomes,

fail or be unsustainable. However, user rights can be difficult to change. Achieving the required change is usually a process not an event. Importantly demonstrating the importance of local knowledge and community led restoration projects can be a stimulus for such change (**Box 11**).

Box 11. Demonstrating local knowledge and capacity to manage sustainably helps promote a human rights based approach to mangrove restoration in Costa Rica Change in governance of tenure of mangroves driven by livelihoods-based community restoration efforts

Mangrove forests are under state governance as Forest Reserves in Costa Rica. CoopeMoluscosChomes R.L. is a cooperative of women and men who make a living from harvesting molluscs in the mangroves on the Pacific coast of Costa Rica (https://www.facebook.com/coopemoluschomes). The local communities, and specifically the mollusc gathering women, did not have land ownership rights or formal access to the resources on which their livelihoods depend. Local knowledge of the communities led the Costa Rican government in 2015 to grant use rights to the cooperative for the first time thanks to a participatory mangrove management plan. At that time 46 people received their right of access but for only one of the 5 species that they traditionally commercialize, due to the lack of "biological studies". However, there are women who are dedicated to harvesting specific mollusc species and the first permits inequitably limited the benefits for many of the women. It also resulted in debt accumulation by the cooperative as it was unable to extract all the species of molluscs that it traditionally harvested.

In 2019, with the support of CoopeSoliDar R.L (https://www.coopesolidar.org/) and Women4Biodiversity (https://www.women4biodiversity.org/) the cooperative carried out mangrove restoration actions to further justify to authorities to prioritize their fundamental rights. This time a special regime granted 35 new licenses for the 5 species of molluscs that this community uses and debts were cancelled. Today, the Cooperative markets its products in a sustainable way and most of its members have their use of the resource legalized and regularized.

Further challenges include a nearby large-scale shrimp aquaculture facility that pollutes the mangrove forest and can constrain access to the concession area for the mollusc women.

 $Further\ information:\ https://youtu.be/n_IGMJHrTls?si=eeE4yTjgSbiMdeiq$

2.4.6.1 Prioritizing low-income groups, people living in conditions of vulnerability and marginalization and food and nutrition security

Multiple ecosystem services are usually in play in any restoration. These services benefit different socioeconomic groups. All socioeconomic groups have "livelihoods". Therefore, approaches need to be clear about which groups are to be prioritized for benefits, and how. In terms of justice and equity, the key consideration is who decides this.

2.4.6.2 Addressing "alternative livelihoods"

Particularly where biodiversity conservation outcomes are prioritized, some platforms can regard livelihoods as a threat to their target ecosystem on the basis that unsustainable use can drive biodiversity loss. The approach promoted here is

consistent with the Ecosystem Approach adopted by the Convention on Biological Diversity, and with principles of justice and equity, where people are considered an integral part of the ecosystem, have a right to continue to benefit from it and be part of the solution for managing it. Achieving sustainable use is part of such approaches and a necessary outcome for successful management.

In assessments of what the actual problem is in a particular area (Section 2.3.3), it is necessary to establish whether any issues linked to over-exploitation are due to ecosystem degradation. In most cases ecosystem degradation will lead to reduced productivity that, other things being equal, will tend to drive unsustainable use. A tenet of the approach promoted here is that restoration of inland aquatic systems will move the direct use of living aquatic resources towards sustainability through: (i) improving biological productivity, and (ii) improved stewardship of the resource by local communities, including community-based measures supporting sustainable use. In addition, several case studies in Coates (2023) demonstrate that community-led restoration also delivers positive outcomes for non-target biodiversity that is not directly used, helping to improve sustainability further.

"Alternative livelihoods" can play an important role in reducing direct use of resources provided they are developed appropriately. But "alternative livelihoods" are often proposed as a convenient solution to unsustainable use either as a perceived driver of ecosystem degradation or resulting from it. This can be over-simplified. For example, results from a household survey in Lao P.D.R. confirm that participation in fishing is common across a range of wealth groups likely due to the low opportunity costs, tradition, enjoyment of fishing, underutilized labour and low capital requirements (Martin, Lorenzen, and Bunnefeld, 2013). "Alternative livelihoods" are therefore unlikely to result in fishers leaving the fishery but instead strengthen their livelihoods portfolio as a supplementary activity. The better approach, in such cases, is to promote improved livelihoods outcomes from within the resource system including through sustainable use and diversified livelihoods.

2.4.7 Identifying ecosystem services

Ecosystem services are the benefits that people obtain from ecosystems. Therefore, local communities and their knowledge should be the first point of entry for mapping benefits, where they arise, for whom and their status and trends. However, such

communities may not be aware of some of the services in play, particularly outside the immediate area. The ecosystem services in play, both in the immediate area, across the entire catchment, and in downstream areas, need to be identified. The list in Section 2.2.1.1 (or alternative source) can be used as guidance or checklist.

The services need to be "mapped" to understand how ecosystem services, ecosystem loss or degradation and ecosystem restoration are impacted by positive or negative changes in the drivers. There is a close relationship between ecosystem service identification, valuation, mapping and the identification of trade-offs and synergies (covered in more detail below) – the approaches and tools should be used together to obtain a holistic picture.

2.4.7.1 Valuing benefits

Although this guidance stresses and prioritizes local community led approaches, including identifying what is important (that is, values), more formal valuations can be useful or necessary when identifying benefits in play. This applies particularly to values delivered off-site and for those that can be invisible or difficult to quantify locally, such as carbon sequestration, water regulation or disaster risk reduction.

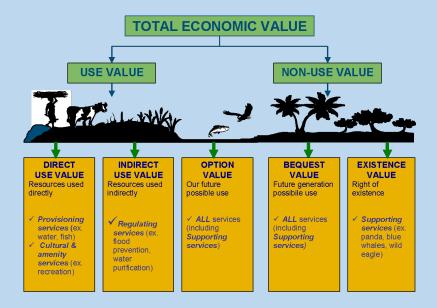
Nevertheless, "economic valuation" (that may or may not include monetary valuation) of ecosystem services can be a powerful tool for identifying synergies with other interest groups. Many of the ecosystem services in play with inland aquatic systems, notably regarding water regulation, can have very high value and be complementary to those services that deliver direct livelihoods benefits. Economic valuation of ecosystem services is only one tool or approach, among many (**Box 12**).

However, in this context, the most important aspect of valuations is who is determining the values, which ones are included or excluded, the process of determining them and how different values are compared, and who decides the value-based outcomes.

Box 12. Sources of guidance on the economic valuation of ecosystem services

Various methods are used to calculate ecosystem service values and are similar across ecosystem types. Some of those commonly used include: contingent valuation, choice modelling, averting behaviour, value transfer, related goods approaches, production function-based, indirect opportunity costs, restoration costs, hedonic pricing, replacement costs and preventive/defensive expenditures (de Groot *et al.*, 2012; Russi *et al.*, 2013; Barredo *et al.*, 2019). Different approaches vary according to precision required and scale of application (for further information see Costanza *et al.*, 2014).

Often, the concept of "total economic value" is used to obtain overall comparable valuations as follows:



Note: The *Ecosystem Services Partnership* (https://www.es-partnership.org) provides useful access to experts, methodologies and guidance. The *Ecosystem Services Valuation Database* (https://www.esvd.net) provides one source of comparative data on valuations.

Source of figure: De Groot, R.S., Stuip, M.A.M., Finlayson, C.M. and Davidson, N. 2006. Valuing wetlands: guidance for valuing the benefits derived from wetland ecosystem services. Ramsar Technical Report No. 3/CBD Technical Series No. 27. Gland/Montreal, Switzerland/Canada, Ramsar Convention Secretariat/Secretariat of the Convention on Biological Diversity (CBD). www.cbd.int/doc/publications/cbd-ts-27.pdf

Sources: See References.

Some contest the commodification of nature through its valuation. There are alternative value systems for ecosystems including "nature's benefits to people" as an alternative to "ecosystem services" and alternative belief systems such as "Mother Earth" (IPBES, 2019) that are recognized throughout this guidance. Whatever the terminology or value system, ecosystem restoration will inevitably involve trade-offs and those trade-offs need some form of value-based decision making. It is stressed that such valuation need not, and should not exclusively,

Box 13. Adding post-harvest value succeeds in improving the status of mollusc gathering women in mangroves in Costa Rica

Financial benefits to mollusc gathering communities in mangroves in Costa Rica (see **Box 11**) not recognize the enormous effort and hazards in harvesting and marketing. The Sea Market (https://www.facebook.com/PescaArtesanalCR) is a response to the COVID-19 pandemic which left coastal communities unprotected by the reduction in tourism and the closure of the beaches where they traditionally carried out their productive activities. The Sea Market, initiative of CoopeSoliDar R.L (https://coopesolidar.org/) and the Network of marine areas for responsible fishing and marine territories of life (https://coopesolidar.org/actividades/proyectos/vigentes/somoslared/) had participation of women in the collection of mangrove products recognized in the value chain. This market improves the direct benefits of the most vulnerable sectors, such as mollusc gatherer women, and promotes and motivates the participation of these rightsholders in the restoration and conservation of coastal ecosystems. However, a market-based solution alone cannot solve the equity problem faced by mollusc women gatherers and other more vulnerable communities; a more comprehensive process that addresses the entire value chain is required.

Further information on the market: https://www.facebook.com/PescaArtesanalCR/videos/626773996218752; Efforts to recognize the work of women: https://www.facebook.com/PescaArtesanalCR/videos/1242032493134394

involve monetary valuation. Monetary values do not necessarily reflect the most important aspects of livelihoods values. Very often, those undertaking valuations have different value and knowledge systems to those who are impacted.

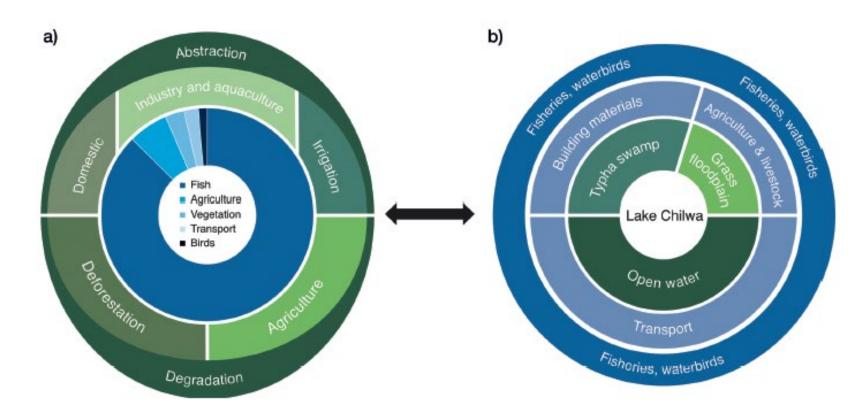
Disregarding these nuances leads to disconnects between objectives, outcomes and beneficiaries.

Ecosystem service values are not static or fixed. Opportunities for increasing values to target groups should be part of any restoration of inland aquatic ecosystems for livelihoods (**Box 13**).

2.4.8 Trade-offs and Synergies

Interactions among ecosystem services and bundles, involving trade-offs and synergies, are usually extensive for inland aquatic ecosystems because of the interactions between people, the surrounding catchment, and its ecosystem services (**Figure 7**). One of the most important trade-off areas for inland aquatic ecosystems is with regards to associated land- and water-use planning because of the potential magnitude of their impacts on aquatic systems.

Figure 7. (a) Cross-scale connections linking the Lake Chilwa wetland (inner circle), the practices in the catchment (intermediate circle) and threats (outer circle) to the wetland; (b) the major wetland components (inner circle) and the main livelihoods activities that are practised in each of these (outer circles)



Source: Used with permission of the Royal Society, reproduced from Kafumbata, D, Jamu, D and Chiotha, S., 2014. Riparian ecosystem resilience and livelihoods strategies under test: lessons from Lake Chilwa in Malawi and other lakes in Africa. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 369, 20130052–20130052.

Trade-offs and synergies are implicit in any form of ecosystem restoration but making them explicit and central is a defining feature of a livelihoods-based compared to an ecology-based focus to the restoration of inland aquatic ecosystems. Trade-offs and synergies among different objectives, values, and stakeholders are involved at multiple scales. Most evaluations of these trade-offs in the academic literature involve monetary valuation or calculation of aggregate production of ecosystem services and have paid relatively little attention to justice and poverty reduction objectives (Schaafsma *et al.*, 2021). In general, trade-offs and synergies involve identifying and dealing with potential conflicts and shared interests among stakeholders and policies.

Most attention is usually paid to trade-offs. Synergy is where one benefit increases the benefits supplied by another that can also translate into benefits for multiple stakeholders. That is, a synergy occurs when ecosystem services interact with one another in a multiplicative or exponential fashion; for example, restoring flooding on wetlands for flood control will usually benefit fisheries. In addition, there are potential synergies among policies and multiple agendas. This creates mutually reinforcing interests among stakeholders or policies. These include identifying how alliances can be mobilised to support restoration, including building bridges among financing interests. Synergies often tend to get less attention than trade-offs but can be as, if not more, important and can be instrumental in successful implementation.

Identifying and dealing with trade-offs and synergies require similar approaches and methods. These involve an interactive process that identifies ecosystem services, drivers, their links to poverty and livelihoods (and for whom), people and their status and power, potential losses and benefits to each affected group from potential restoration measures, and ways and means of minimising negative and maximizing positive outcomes. This is by no means a simple process. Common scientific tools for assessing trade-offs and synergies include mapping services and benefits in a "spiders web" using different scenarios to illuminate which services increase or decrease the size of a benefit (the slice of the pie) for each area (e.g. Howe *et al.*, 2014). Assessments that examine socio-cultural preferences toward ecosystem services can serve as a tool to identify relevant services for people, the factors

underlying these social preferences, and emerging ecosystem service bundles, trade-offs and synergies (e.g. Martín-López *et al.*, 2012).

A detailed analysis of trade-offs and synergies is usually complex and involves such factors, for example, as scale, time lags, feedbacks and thresholds in the complex interactions between biodiversity, ecosystem services, human activities and human wellbeing (Folke, 2006). Power structures are crucial to outcomes. In practice, the way in which decisions are usually made is almost inevitably inequitable and often unsustainable and likely to benefit the powerful at a cost to the poor and powerless (Whittaker *et al.*, 2018). Hence this report stresses the importance of ensuring that the decision-making process leads to the highest probability of the priority target groups benefiting from restoration.

Trade-offs and synergies are not limited to between local and distant stakeholders. Local communities themselves are far from homogenous and typically comprise households with a diversity of livelihoods, aspirations and wealth classes influenced by gender, age, social status, ethnicity, religion, family relationships among many other factors.

Some of the most important trade-offs and synergies occur at policy level. On the downside, policies that have prioritized provisioning services have resulted in an imbalance in ecosystem services that often impacts the poorest groups (IPBES, 2019). Inland aquatic ecosystems are particularly vulnerable to land and water use policies that can be at the heart of these negative trends. For example, land use change, water resources use, infrastructure and pollution, and other aspects of environmental degradation, are the main drivers of declines in inland fisheries and the consequent impact on livelihoods of the rural poor and food and nutrition security (Funge-Smith, 2018; Funge-Smith and Bennett, 2019). This trend is exacerbated by the lack of recognition of fish in policy discourses on food and development funding (Bennett *et al.*, 2021).

However, there are also some very powerful policy synergies in play. There is increasing recognition of the importance of concepts such as nature-based solutions and ecosystem-based approaches, both of which usually involve or are restoration, for addressing multiple policy areas. For example, the synergies between climate

change and nature are now well established (e.g. Bulkeley *et al.*, 2023). These synergies are particularly relevant to inland water ecosystems because of their prominent role in regulating water and carbon and hence their intimate relationship with water and climate security (**Box 14**). Provided that livelihoods considerations are properly integrated into policies, planning and funding, these linkages create access to funding at a much greater scale than is usually available for restoration of inland water ecosystems-based on direct livelihoods dependency alone. Having livelihoods as a co-benefit of investments in inland aquatic ecosystem restoration driven by other priorities should be welcome.

Usually, because of the prominence of these other policy areas, livelihoods aspects of inland aquatic ecosystems will need to be integrated into relevant funding policies and proposals. Building alliances between stakeholders and policy areas is the major way forward in accelerating investment in restoration of inland aquatic ecosystems.

Box 14. Examples of synergies across multiple policy areas for inland aquatic ecosystems

The economic use value of water from freshwater ecosystems in 2021 was estimated at approximately USD 58 trillion, equivalent to 60 percent of global GDP (WWF, 2023). This includes a total quantifiable direct use value of a minimum of USD 7.5 trillion and an additional USD 50 trillion annually, seven times more, from the indirect benefits that are currently chronically undervalued in policies. These values eclipse any values derived from direct use of living inland aquatic resources and probably for livelihoods benefits too – due to water underpinning most economic activities, ecosystem function and human health.

Climate change largely impacts water resources and, therefore, inland aquatic ecosystems are highly vulnerable. The conservation and restoration of inland aquatic ecosystems is a priority response for climate change adaptation using nature-based solutions (WWAP and UN-Water, 2018).

Wetlands contain a disproportionate amount of the earth's total carbon store despite occupying less than 5 percent of its land surface, storing three times the carbon held in the world's forests (Parish *et al.*, 2008). Consequently, inland wetlands are among the most important ecosystems to mitigate climate change and among the most important, cost-effective and efficient options for sequestering atmospheric CO₂ (Were *et al.*, 2019).

Inland fisheries have very low carbon emissions compared to other food production systems. The value of inland fisheries through costs avoided costs from alternative production systems is under-recognized and presents a major justification for funding their conservation and restoration, including via climate finance (Coates *et al.*, 2025).

These, and many other, relationships create strong links between these policy areas and the restoration of inland aquatic ecosystems for livelihoods.

Sources: See References.

2.4.8.1 Tools for dealing with trade-offs and harnessing synergies

There is much detailed guidance available on approaches to dealing with trade-offs and synergies; examples, among many others, include those of a general nature such as IUCN (2021) and Schaafsma *et al.* (2021). Examples specifically for wetlands-based livelihoods include lessons from Lake Chilwa in Malawi (Kafumbata, Jamu and Chiotha, 2014), for a small-scale fishery in Kenya (Daw *et al.*, 2015), the use of wetland ecosystem services by local communities in rural Zimbabwe (Mandishona and Knight, 2022), and an equitable and inclusive multi-stakeholder approach to improve fish production, income and food security in Bangladesh (Haque and Dey, 2017).

A "balance sheet approach" can be useful and applied at various analysis scales involving a variety of economic, social and ecological principles, assessment methods and techniques (**Figure 8**).

Figure 8. Example of a balance sheet approach to trade-off and synergy assessment for restoration of inland aquatic ecosystems

Strategic macro analysis Meso-scale impact analysis Plural/local values Economic principles: Economic principles: Social principles: Local impacts and economic Efficient and equitable resource use Recognition of ethics and Social principles: multipliers rights Environmental justice Value pluralism, meaningful Social principles: Inequality reduction, actual Compensation measures (e.g. participation and compensation PES, biodiversity offsets) deliberation · Inclusiveness, transparency, Ecological principles: **Employment** Conservation accountability, legitimacy Local identity Assessment methods: Techniques: Ecological principles: Extended cost-benefit analysis Downscaled models and Resilience and Environmental impact assessment scenarios precautionary principle Techniques: Maintenance/improvement Land-use and wetland National indicators (e.g. GDP, HDI, mapping of natural capital Economic multiplier analysis Assessment methods: Economic and financial valuation Social capital status Multi-criteria analysis Scoping: natural capital asset Symbolic and cultural asset Techniques. Household surveys checks checks (qualitative or Scenario analysis quantitative valuation) Focus groups Group and deliberative Systems modeling Network analysis approaches Trade-off matrices **Ecosystem change context** Complex, dynamic Slower, simple

Source: Schaafsma, M., Eigenbrod, F., Gasparatos, A., Gross-Camp, N., Hutton, C., Nunan, F., Schreckenberg, K. and Turner, K. 2021. Trade-off decisions in ecosystem management for poverty alleviation. *Ecological Economics*, 187, 107103. https://doi.org/10.1016/j.ecolecon.2021.107103, https://creativecommons.org/licenses/by/4.0/

Box 15. Examples of synergies across multiple policy areas for inland aquatic ecosystems

The economic use value of water from freshwater ecosystems in 2021 was estimated at approximately USD 58 trillion, equivalent to 60 percent of global GDP (WWF, 2023). This includes a total quantifiable direct use value of a minimum of USD 7.5 trillion and an additional USD 50 trillion annually, seven times more, from the indirect benefits that are currently chronically undervalued in policies. These values eclipse any values derived from direct use of living inland aquatic resources and probably for livelihoods benefits too – due to water underpinning most economic activities, ecosystem function and human health.

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These, and many other, relationships create strong links between these policy areas and the restoration of inland aquatic ecosystems for livelihoods.

Sources: See References.

Stakeholder analysis is key. Important aspects include:

- o identifying and engaging with all stakeholders within and beyond the ecosystem from the beginning. This requires a combination of an ecological and social approach. Stakeholders can identify ecosystem services (and their values) and ecosystem service assessments can identify stakeholders, particularly those that might otherwise be invisible:
- o pay particular attention to the status, role and power of women (**Box 15**);
- avoid assumptions that stakeholders are limited to within the boundaries of the restoration area;
- o to ensure effective livelihoods outcomes, attention should be given to institutions, power, and agency, which dictate how different people

- interact with resources and themselves attain livelihoods outcomes and influence how decisions are made:
- o the socio-economic status of stakeholders must be known, including gender and vulnerability. Disaggregate results, by location, socio-economic conditions, status and gender, whilst recognizing not only how they benefit or are impacted by changes in ecosystem services but their potential roles in restoration; and
- mapping the power/influence and interest of stakeholders informs tradeoffs and synergies. Stakeholders can be categorised according to their interest and power, then criteria can be applied to prioritizing their influence and ways and means of engaging with each identified (Box 16).

Box 16. Mapping stakeholder interests and power

Mapping stakeholders not only helps identify trade-offs and synergies but importantly helps identify those stakeholders that may not be targeted or benefit but that could nevertheless significantly influence project outcomes. There are ample tools available to assist with this.

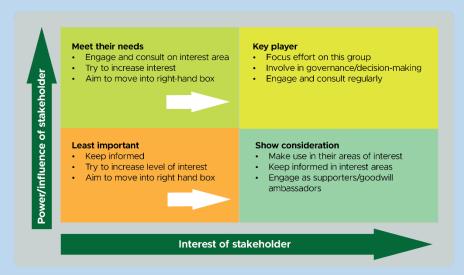
Stakeholder mapping, particularly using *power-influence mapping* is a common starting point (e.g Murray-Webster and Simon, 2006). For example, along the following lines:

- The salience model approach (e.g. Mitchell, Agle and Wood, 1997) identifies various classes of stakeholders:
 - o Discretionary stakeholders have little urgency or power and are unlikely to exert much pressure. But they have legitimate claims.
 - o Dormant stakeholders have much power but no legitimacy or urgency and therefore are not likely to become heavily involved
 - o Demanding stakeholders have little power or legitimacy but can be disruptive because they want things to be addressed quickly
 - o *Dominant stakeholders* have both formal power and legitimacy, but little urgency. They tend to have certain expectations that must be met.
 - o Dangerous stakeholders: have power and urgency but are not really pertinent to the project.
 - o Dependent stakeholders: have urgent and legitimate stakes in the project but little power. These stakeholders may have to lean on another stakeholder group to have their voices heard.
 - o Definitive stakeholders have power, legitimacy and urgency and therefore have the highest salience.
 - o Non-stakeholders: have no power, legitimacy or urgency and are beyond considerations.

Other approaches and methodologies are available. The group "dependent stakeholders" would characterize the primary target stakeholder group for restoration of inland ecosystems for livelihoods) – but critically, these are often not empowered to influence outcomes (unless empowered to do so through project interventions). Meanwhile, other stakeholders (e.g. dangerous stakeholders) have the power to disrupt achievement of project objectives.

Box 16 (Cont.)

The various stakeholders, their interests and powers can be mapped to determine strategies for each; for example:



Sources: Mitchell, R.K.; Agle, B.R. and Wood, D.J. 1997. "Toward a Theory of Stakeholder Identification and Salience: Defining the Principle of Who and What Really Counts". *The Academy of Management Review*, 22 (4), 853–886 (https://doi.org/10.5465/amr.1997.9711022105); Murray-Webster, R. and Simon, P. 2006. Making Sense of Stakeholder Mapping. *PM World Today*, 8(11), 1–4.

2.4.9 Addressing drivers of ecosystem degradation

Ecosystems need to be restored because previous, or ongoing, factors or threats (drivers) have degraded, or continue to degrade, them. These drivers must be addressed by removing or mitigating them if restoration benefits are to be sustained. Attention should focus on the direct drivers – those that directly impact an ecosystem locally (for example water pollution, obstruction of water flows, obstruction of fish passage, dredging, or land conversion). Participatory community involvement is key to identifying these (e.g. Rakotomahazo *et al.*, 2019). Often, removing or mitigating the drivers can lead to self-recovery of an ecosystem on its own (passive restoration), provided all the drivers are known and managed (**Box 17**).

Indirect drivers (e.g. institutional policies) are also essential to understand and often more difficult to address. Government policies are often a leading driver of ecosystem degradation and shifts in policy approach can be a significant enabler of restoration of inland aquatic ecosystems (**Box 18**).

Box 17. Addressing the right drivers is key to mangrove restoration

Mangrove forest ecosystems support an immense array of aquatic life; they serve as vital fish nurseries, for both coastal and inland fisheries, and inland fishing habitats, as well as being important carbon stores and providing coastal protection. Yet, mangroves are one of the most threatened ecosystems.

While there have been many successful mangrove restoration efforts, some regions still see failure rates of up to 80 percent due to poor project planning and lack of local engagement, reliance on planting in unsuitable areas, or planting without also addressing hydrology, nutrient, and sedimentation requirements (Kodikara *et al.*, 2017). Conventional scientific wisdom was a "gardening" approach – building a nursery, growing seedlings, and planting mangroves. This often failed. Recent approaches centre on addressing the drivers of degradation such through restoring hydrology that once enabled healthy mangroves to thrive (Beeston *et al.*, 2023). Community-Based Ecological Mangrove Restoration seeks to empower local communities to restore and steward their mangroves while deriving sustainable mangrove-based livelihoods, including fisheries (Quarto and Thiam, 2018). This works to restore underlying hydrology, and other relevant factors, and considers adjustments to a disturbed area's topography, so that mangroves may regenerate naturally. Key to success is participation of local communities who hold important local knowledge, including for the drivers of degradation and how to address them.

In Myanmar, on the other hand, the community identified a suitable site, agreed that it was appropriate, having good hydrology, plenty of fresh water and seeds /propagules available. But in this case restoration failed to naturally regenerate due to grazing and trampling by livestock (Beeston *et al.*, 2023) illustrating the need for ensuring all stakeholders are identified and engaged.

Sources: Beeston, M., Cameron, C., Hagger, V., Howard, J., Lovelock, C., Sippo, J., Tonneijk, F., van Bijsterveldt, C. and van Eijk, P. (Eds.). 2023. *Best practice guidelines for mangrove restoration*; Kodikara, K.A.S., Mukherjee, N., Jayatissa, L.P., Dahdouh Guebas, F. and Koedam, N. 2017. Have mangrove restoration projects worked? An in-depth study in Sri Lanka. *Restoration Ecology*, 25(5), 705-716 (https://doi.org/10.1111/rec.12492); Quarto, A. and Thiam, I. 2018. Community-Based Ecological Mangrove Restoration (CBEMR): re-establishing a more biodiverse and resilient coastal ecosystem with community participation. *Nature & Faune*, 32(1): 39-45. Rome: FAO. https://openknowledge.fao.org/handle/20.500.14283/i9937en.

Box 18. Government policies as a driver of degradation and enabler of restoration of inland aquatic ecosystems – the case of rice paddy production

Rice is one of the world's most important crops for both food security and farmer livelihoods. Traditionally, rice fields are multifunctional. Rice fields can support high levels of biodiversity that also increases livelihoods options for farming communities (Bambaradeniya and Amerasinghe, 2003). In both flood and dry seasons, rice field fishery catch provided around 60 percent of the fish and aquatic animals consumed in surveyed households in Cambodia (Freed *et al.*, 2020).

Early rice intensification programs targeted poverty reduction and improved food availability but at the expense of other ecosystem benefits. In common with many countries, Vietnam adopted a rice intensification policy aimed at a rice surplus for export by the 1990s that drove major land-use and hydrology changes, and unsustainable inputs of agro-chemicals, in the Mekong River Delta (Nguyen, Dumaresq and Pittock, 2018). Rice production significantly increased but farm household fisheries

Box 18 (Cont.)

catch, collection and consumption of other aquatic animals and plants decreased with significant wet and dry season variation in food availability. Poor households experienced most loss and overall household food security was affected and, therefore, rice intensification policies aimed at global food security need to balance wider population access to a food staple with the need for rice farming communities to maintain access to and livelihoods-based on high quality wild foods obtained from the fields and waterways of rice farming landscapes (Nguyen, Dumaresg and Pittock, 2018).

Approaches to rectify these negative impacts involve restoring ecological functioning in rice systems using various approaches. For example: an ecological rice-animal co-culture system (e.g. rice-fish, rice-duck, and rice-crayfish) can not only reduce the demand for agricultural land areas, but also increase rice yields (+4 percent), nitrogen use efficiency of rice (+6 percent), reduces nitrogen losses (-16 percent runoff and -13 percent leaching) and methane emissions (-11 percent), compared to traditional monoculture of rice; and, increase the net income of farmers through reducing cost of fertilizer and pesticide input and achieving higher outputs with more marketable products (Cui *et al.*, 2023). The System of Rice Intensification is an agro-ecological methodology for increasing the productivity of irrigated rice by changing the management of plants, soil, water and nutrients, including via restoring soil ecosystem health. Among other benefits, grain yields increase, delivering a direct benefit to both subsistence and commercial farming households, and productivity of water and seed inputs increase. Consequently, the system is more accessible and affordable to poor and marginal communities and farmers facing water scarcity (Lal *et al.*, 2016).

The Sustainable Rice Landscape Initiative^a is a partnership of FAO, GIZ, IRRI, SRP (Sustainable Rice Platform), UNEP and WBCSD (World Business Council for Sustainable Development) to promote systematic policy change to enable rice smallholders to adopt more sustainable practices to generate multiple social, environmental and economic benefits, including:

- Healthier watersheds and biodiversity protection
- On-farm and landscape resilience
- Increased water and fertilizer use efficiency
- Lower greenhouse gas emissions from rice production
- Reduced agrochemical pollution
- Improved farmer health and livelihoods
- Strengthened consumer markets for sustainably produced rice.

Sources: Bambaradeniya, C.N.B. and Amerasinghe, F.P. 2003. Biodiversity associated with the rice field agroecosystem in Asian countries: A brief review. Working Paper 63. Colombo, Sri Lanka: International Water Management Institute; Cui, J., Liu, H., Wang, H., Wu, S., Bashir, M.A., Reis, S., Sun, Q., Xu, J. and Gu, B. 2023. Rice-animal co-culture systems benefit global sustainable intensification. Earth's Future, 11(2), p.e2022EF002984 (https://doi.org/10.1029/2022EF002984); Freed, S., Kura, Y., Sean, V., Mith, S., Cohen, P., Kim, M., Thay, S. and Chhy, S. 2020. Rice field fisheries: Wild aquatic species diversity, food provision services and contribution to inland fisheries. Fisheries Research, 229, p.105615 (https://doi.org/10.1016/j.fishres.2020.105615); Lal, B., Nayak, A.K., Gautam, P., Tripathi, R., Shahid, M., Panda, B.B., Bhattacharyya, P. and Rao, K.S. 2016. System of Rice Intensification: A Critical Analysis. Research Bulletin No. 9. ICAR-National Rice Research Institute, Cuttack, Odisha, 753006, India. 52 p. (https://icar-nrri.in/wp-content/uploads/2019/08/11.-NRRI-Research-Bulletin-9.pdf); Nguyen, V.K., Dumaresq, D. and Pittock, J. 2018. Impacts of rice intensification on rural households in the Mekong Delta: emerging relationships between agricultural production, wild food supply and food consumption. Food Security, 10, 1615–1629 (https://doi.org/10.1007/s12571-018-0848-6)

^a https://www.fao.org/asiapacific/partners/networks/rice-initiative/fr/

2.4.10 Accounting for biodiversity

Relevant aspects of biodiversity are:

- i. biodiversity underpins ecosystem functions (Figure 3) that is, it is an "engine" of ecosystem processes that deliver the services or "benefits" (Box 5);
- ii. where "biodiversity" is directly used for example as food or medicine those benefits are already included under provisioning services;
- iii. the aesthetic and recreational values of biodiversity (such as landscape values), that support e.g. tourism benefits, are included under cultural services. Also included in this category are values (or benefits) such as "intrinsic" values of biodiversity (e.g. a perceived "right" of biodiversity to exist, or nature for nature's sake) because they can be considered as human-centric concepts and therefore as cultural services; and
- iv. "biodiversity" is often an integral, and inseparable, aspect of alternative value systems for people's relationship with nature (IPBES, 2022).

This account of the relevant aspects of biodiversity is by no means universally accepted. In the current context the key point is that the various perceptions of biodiversity are important to factor into assessments and monitoring. Whether considered a direct, indirect or co-benefit, biodiversity loss is usually an element and often a driver of ecosystem degradation and therefore can be the direct target of restoration efforts.

Biodiversity is usually a co-benefit of improved ecosystem conditions. Biodiversity directly supports livelihoods and sustainable use of biodiversity is often essential to sustain biodiversity (**Box 19**). For example, there is much documented evidence that efforts of local communities to restore ecosystems to support fisheries-based livelihoods are accompanied by improvements in non-fisheries related biodiversity as well (Coates, 2023; Kura *et al.*, 2023).

Box 19. Examples of livelihoods and biodiversity co-benefits

All the case studies included in Coates (2023) highlight that biodiversity is a co-benefit of community-led restoration of inland aquatic ecosystems for fisheries. This includes also non-fisheries related biodiversity (such as waterbirds).

Livelihoods outcomes drove the restoration of Chilika Lake, a large brackish water coastal lagoon on the east coast of India. Biodiversity co-benefits were many and included an increase in the population of endangered Irrawaddy dolphins from 89 to 158 between 2003 and 2015, and an expansion of the seagrass meadows from 20 km² in 2000 to 80 km² (Pattnaik and Kumar, 2018). Some fisher communities stopped waterbird hunting and shifted to ecotourism, so as to benefit from improved habitat quality of Chilika. This transition increased their income over 2.5 times in the last two decades bringing considerable incentives to these communities for stewardship of Chilika (Kumar *et al.*, 2016).

Integrating the benefits associated with biodiversity into market mechanisms can play an important role in financing restoration of inland water ecosystems and conservation practice. Food labelling is a widely used measure that highlights biodiversity conservation benefits to the market. There is a significant 20 percent price premium on biodiversity-relevant labels on rice prices in Japan and outcome-based certifications have the potential to work well in the market (Mameno, Kubo and Shoji, 2021).

Sources: Coates, D. 2023. Ecosystem restoration and inland food fisheries in developing countries – opportunities for the United Nations Decade on Ecosystem Restoration (2021–2030). FAO Fisheries and Aquaculture Circular No. 1231. Rome: FAO. https://doi.org/10.4060/cc7082en.

Kumar, R., Ambastha, K., Kumar, S., Chakraborty, A., Dalakoti, K. and Meetei, A.Y. 2016. *Economics of Ecosystem Services and Biodiversity for Conservation and Sustainable Management of Inland Wetlands*. The Economics of Ecosystems and Biodiversity India Initiative. GIZ India. 96 p.

Mameno, K., Kubo, T. and Shoji, Y. 2021. Price premiums for wildlife-friendly rice: Insights from Japanese retail data. *Conservation Science and Practice*, 3(6), p.e417. https://doi.org/10.1111/csp2.417

Pattnaik, A. K. and Kumar, R. 2018. Lake Chilika (India): Ecological restoration and adaptive management for conservation and wise use. In: Finlayson, C.M., Milton, G.R., Prentice, R.C. and Davidson, N.C. (eds.). *The Wetland Book II: Distribution, Description, and Conservation*. Netherlands: Springer. https://doi.org/10.1007/978-94-007-4001-3 177.

However, although mutually positive biodiversity and livelihoods outcomes from restoration should be an outcome of most restoration for livelihoods this should not be assumed. Rigorous and broad biodiversity assessments should be integral to restoration strategies, programmes, and projects. Identifying where biodiversity and livelihoods are mutually supportive can strengthen the "business case" for restoration.

2.4.11 Accounting for "ecosystem functions"

There is a close relationship between "ecosystem functions" and "ecosystem services". "Ecosystem function" is the capacity of natural processes and components to provide goods and services that satisfy human needs, either directly or indirectly (De Groot, Wilson and Boumans, 2002). "Ecosystem services" are the

ecological characteristics, functions, or processes that directly or indirectly contribute to human well-being – the benefits people derive from functioning ecosystems (Costanza *et al.*, 1997). Ecosystem processes and functions may contribute to ecosystem services but they are not synonymous. Ecosystem processes and functions describe biophysical relationships and exist regardless of whether or not humans benefit (Granek *et al.*, 2010). Ecosystem services, on the other hand, only exist if they contribute to human well-being and cannot be defined independently. For practical purposes most relevant ecosystem functions are measured in terms of the services (benefits) they deliver. Usually, simplified approaches are required and functions and services are often considered together. Further guidance for rapid assessment of wetland functions and services is provided by Ramsar Convention (2018).

2.4.12 Building sustainability

Relevant dimensions of sustainability include socio-economic, ecological, institutional and political. These dimensions are inter-linked. For example, socio-economic sustainability can support ecological sustainability (and vice-versa), sustained institutions are needed to sustain management, long-term political support can determine longevity of outcomes and successful outcomes can muster political support.

Assessments should factor in the need for, and value of, inland aquatic ecosystems as support measures for livelihoods in times of shock or stress; for example, to food security in times of a local crop failure or civil or economic disruption (Funge-Smith and Bennett, 2019). These values can be high and are often not manifest locally at the time assessments are made. Potential changes to ecosystem dynamics (e.g. landscape characteristics, hydrological shifts, pollution loads) can have a major bearing on sustainability. Climate change mitigation and adaptation, and disaster risk reduction, should form a central part of planning for sustainability (**Box 20**; see also **Box 14**). Climate change impacts livelihoods directly, through for example ecosystem changes impacting ecosystem services, or indirectly, for example through responses to climate change (e.g. increased water storage). Resilience to a range of scenarios should be in-built to cater for known and unknown uncertainties (risks).

Box 20. Climate change adaptation in the Mekong Delta

The Mekong River Delta supports a very important capture fishery and aquaculture industry but is particularly vulnerable to the impacts of climate change, especially sea level rise and attendant increased flooding (both coastal and riverine) and coastal salinity that can exacerbate transboundary impacts from upstream development. Kam et al. (2012) showed that shrimp farmers overall can bear the cost of adaptation over a longer time frame than catfish farmers. The shrimp industry is more mature and less capitalized and so will remain profitable for longer than catfish under a climate change scenario. Despite its lower profitability compared with the semi-intensive/intensive system, improved extensive shrimp culture is more sustainable, both environmentally and economically, especially for small-scale farmers. Adaptation costs borne by farmers can be reduced or offset by planned adaptation measures, such as construction of coastal and river dikes to control floods and intrusion of saline waters into the delta. On the other hand, complete polderization of the delta would reduce opportunities for expanding brackish-water aquaculture. A more thorough integrated assessment of the economics of planned adaptation is needed. Diversification through restoration to more ecologically sustainable and diversified production systems will hedge the aquaculture industry against increasing risks to shrimp and catfish farming and the uncertainties brought about by climate change. It is imperative to adopt a holistic land- and water-use planning approach to explore synergies in adaptation and mitigation strategies between coastal protection, agriculture, aquaculture and fisheries to derive greater co-benefits from these strategies.

Agricultural systems in Mekong Delta are transforming to cope with climate change. Integrated agriculture-aquaculture farming systems (i.e., rice-shrimp, rice- fish) have emerged as potential climate adaptive practices. Rice-shrimp systems have the potential to improve livelihoods, food security, and adaptation of coastal farmers with restoration as a key measure to achieve major improvements in productivity, efficiency, and equity (Dang, 2020).

Sources: Dang, H.D. 2020. Sustainability of the rice-shrimp farming system in Mekong Delta, Vietnam: a climate adaptive model. *Journal of Economics and Development*, 22(1), 21-45. https://doi.org/10.1108/JED-08-2019-0027. Kam, S.P, Badjeck, M.C., Teh, L., and Tran, N. 2012. *Autonomous adaptation to climate change by shrimp and catfish farmers in Vietnam's Mekong River delta*. Working Paper: 2012-24. https://hdl.handle.net/20.500.12348/926.

2.4.13 The enabling environment

Restoration occurs within a broad policy landscape. Factors "outside" the immediate planning domain can be very influential on either constraining or supporting success. A wide range of policy, administrative, management, institutional and other supporting elements (**Figure 9**) usually need to be considered. These include policies and their relevant laws and regulations that influence restoration efforts and outcomes. These can help define the objectives and principles for the restoration work, provide influence and power to proposals, and either support or constrain implementation, including determining the legal rights and autonomy possessed by local communities (**Box 14**). Consideration must be given not only to the policies and institutions that might seem to be most directly relevant, such as environment,

Box 21. Enabling conditions for supporting mangrove restoration

Payments for ecosystem services (PES) design frameworks developed under the Reduction of Emission from Deforestation and Forest Degradation (REDD+) mechanism of the United Nations Framework Convention on Climate Change were used to assess the enabling environment for mangrove restoration in Madagascar. Semi-structured interviews with national and local stakeholders were conducted to identify the institutional interplay between PES and mangroves and challenges faced with the implementation of PES in the mangroves. Environmental, fisheries and land use planning policies that concern mangrove management were coherent with the frameworks and supportive of PES implementation. But lack of clear legal frameworks and coordination between the sectoral ministries, weakness of government organisations due to political instability, and limited local governance capacity were the major challenges to the PES schemes. These led to lower motivation to collaborate in mangrove conservation efforts among the members of local communities.

Source: Rakotomahazo, C., Ranivoarivelo, N.L., Razanoelisoa, J., Todinanahary, G.G.B., Ranaivoson, E., Remanevy, M.E., Ravaoarinorotsihoarana, L.A. and Lavitra, T. 2023. Exploring the policy and institutional context of a Payment for Ecosystem Services (PES) scheme for mangroves in southwestern Madagascar. *Marine Policy*, 148, p.105450. https://doi.org/10.1016/j.marpol.2022.105450

fisheries and land-use planning, but also to broader policies and institutional constraints that can have a significant impact on restoration outcomes (**Box 21**). Institutions can include a large and important organization (such as a government department or university that exists to serve a public purpose such as education or support for people who need help), a custom or tradition that has existed for a long time and is accepted as an important part of a particular society (such as world views and beliefs), social structures (for example, family, education, government, religion, economy), among others, An institution is composed of interrelated parts, each of which serves a function and (ideally) contributes to the overall stability of the society. Freed *et al.* (2020) provide a case study reflecting the importance of institutional policies and practices in promoting or constraining restoration relevant activities in rice fish production system for livelihoods, food and nutrition security and climate change adaptation.

Mapping and understanding the institutional arrangements can help:

- establish the mandate and accountability for restoration;
- coordinate between different sectors or policy domains;
- ensure financial and other resources are available to support implementation and manage ongoing costs;

- to obtain science, monitoring and research as well as to assess compliance and impact (through monitoring) and to support adaptive management; and
- to access tools and practices used in or available from other sectors (e.g. integrated water resources management, sustainable land management) that can often be compatible but can perhaps undermine implementation (for example, policies that negatively impact prospects for restoration, see Box 18 for an example for rice).

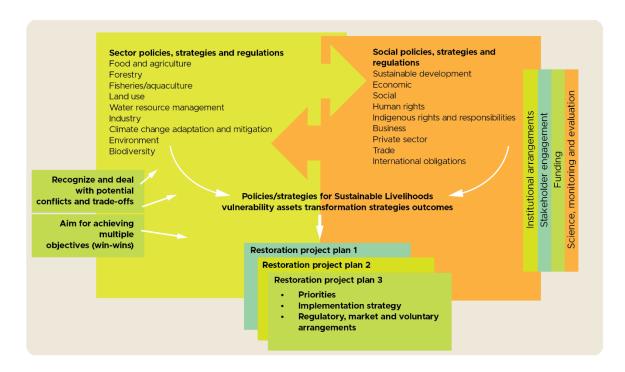
Key questions regarding institutions include:

- How are the relevant drivers and potentials for outcomes governed, by whom and how?
- How do these arrangements affect restoration options and plans?
- How do governance arrangements need to change to maximize prospects for successful outcomes?

Align relevant policies and plans across multiple domains:

- Relevant domains might include: social, economic, environmental policies;
 local, national and international goals (e.g. the Sustainable Development Goals)
- Restoration interventions should not be undertaken in isolation from the broader policy landscape
- A multitude of related policies, instruments, and plans, operating at multiple scales and across multiple domains and sectors, are relevant to ecosystem restoration for livelihoods in inland aquatic systems (Figure 9). These various policies and policy domains should be aligned. Policies can sometimes conflict and need to be addressed through discussions and negotiations among relevant stakeholders. But more often a strong attribute of ecosystem restoration is its ability to deliver across multiple policy areas (Coates, 2023)
- These considerations include the important aspect of local policies and in particular local community rules, traditions, and norms.

Figure 9. Examples of linkages between policies for interventions in restoration for inland aquatic ecosystems for livelihoods and broader domains and their policies, strategies and regulations



2.4.14 Defining the scope and scale of the restoration

Establishing the scope of restoration is obviously a critical need. Even at the smallest intervention unit, ecosystem restoration is most likely complex. Considerations based on livelihoods outcomes increase complexity and are different to considerations based solely on ecological outcomes.

Practicalities require the identification of specific systems to work with within intervention timelines. Work at the appropriate scale and recognize its ecological, social, economic, political and institutional dimensions:

- Scale is not just a physical or ecological concept (such as defining geographic boundaries or ecological connectedness)
- Scale includes at the landscape / ecosystem function, social, economic,
 political and institutional levels. For example:
 - governance, e.g. engaging with traditional, community, local,
 regional, or national governance arrangements; local rules and
 norms versus formal local and national government arrangements;

- local to regional communities (which communities?);
- local traditional/community practices and norms versus local,
 regional and national political realities and policies;
- economic scale such as improving local direct livelihoods benefits
 (e.g. increasing fish catches), and adding further economic value at
 the site (e.g. post-harvest technologies and improving economic
 factors beyond the site, Box 9; marketing strategies, value chains
 product standards Box 13); and
- which institutions are most relevant and how will they be engaged with?

Restoration measures need to address relevant influences wherever they may be. In many cases, coordinated planning, implementation and monitoring of restoration activities needs to be coordinated on a regional scale in addition to local-scale interventions. In many cases there is a trade-off between working at local *versus* larger scales. Larger scales can be more challenging but might deliver greater benefits provided they remain aligned with, and monitored with regards to, livelihoods, poverty reduction and food and nutrition security. Irrespective, they should always be addressed where they exert a significant influence on the project site (that is from "outside" it). Ideally, restoration should be implemented at multiple scales with local interventions supported by relevant enabling interventions at regional and basin-wide scales.

2.4.15 Financing restoration

Costs of restoration of inland aquatic systems vary considerably depending on local and national settings and measures required. They can be very high cost where built infrastructure (such as dams or housing) requires removal. But they can also be low-cost and effective, particularly where local community driven, with many undertaken with limited or no external support (e.g. Coates, 2023). Even where costs are thought to be low (or even negligible) care should be taken to clearly identify full costs and sources of financing. This should include costs during the project period and costs of post-project management and monitoring.

The analysis of those that benefit from the increase in ecosystem services that restoration delivers and those that can provide the increase creates opportunities for payments schemes for ecosystem services (PES). This has been used extensively for watershed services schemes and/or water funds (UNESCO and UN-Water, 2023) and is increasingly used for climate change mitigation funding (**Box 22**). However, the legal, policy and governance conditions need to enable and not constrain restoration efforts.

Restoration has enormous potential to generate market and non-market benefits for different types of investors. Nature-smart policy pathways are less financially and politically costly to implement than they are perceived to be (World Bank, 2022).

At the institutional, national, or regional levels, a key challenge is enabling locally led initiatives to access capital from large national or international financial institutions and donors. It is critical to improve the efficiency and standardization of portfolios so such financing can be scaled up (World Bank, 2022). Lessons and best practices can be drawn from programmes such as *Initiative 20x20*⁸, *AFR100*⁹, and the *Great Green Wall Initiative*¹⁰. A UN system contact portal is through the UN Decade Finance Task Force¹¹ established to catalyse actions which can contribute to unlocking the capital needed to meet the goals of the UN Decade on Ecosystem Restoration 2021–2030.

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⁸ https://initiative20x20.org

⁹ https://afr100.org

¹⁰ https://www.unccd.int/our-work/ggwi

¹¹ https://www.decadeonrestoration.org/task-forces/finance

Box 22. Carbon markets as a source of funding for restoration of inland aquatic ecosystems for livelihoods

Mangrove ecosystems store high levels of carbon and are more efficient at sequestration than terrestrial forests. They are also very important for local livelihoods. *Tahiry Honko*, in Madagascar, winner of the 2021 IUCN Pathfinder Award in the climate change category, is the world's largest community-led mangrove conservation and restoration project. The generation and sale of carbon credits (Plan Vivo certificates, http://www.planvivo.org) on the voluntary carbon market financed mangrove management and restoration and provided an additional source of income for mangrove users (Rakotomahazo *et al.*, 2019).

However, lack of clear legal frameworks and coordination between the <u>sectoral</u> ministries, weakness of government organisations due to political instability, and limited local governance capacity are the major challenges for the implementation of PES schemes in mangroves. These led to lower motivation to collaborate in mangrove conservation efforts among the members of local communities. The existence of the mangrove PES initiative can be a catalyst for Madagascar to develop clear policy, legislation, and institutions to support effective implementation of the schemes (Rakotomahazo *et al.*, 2023).

Source: Rakotomahazo, C., Aigrette Ravaoarinorotsihoarana, L., Randrianandrasaziky, D., Glass, L., Gough, C., Todinanahary, G.G.B. and Gardner, C.J. 2019. Participatory planning of a community-based payments for ecosystem services initiative in Madagascar's mangroves. Ocean & Coastal Management, 175, 2019, 43-52. https://doi.org/10.1016/j.ocecoaman.2019.03.014. Rakotomahazo, C., Ranivoarivelo, N.L., Razanoelisoa, J., Todinanahary, G.G.B., Ranaivoson, E., Remanevy, M.E., Ravaoarinorotsihoarana, L.A. and Lavitra, T. 2023. Exploring the policy and institutional context of a Payment for Ecosystem Services (PES) scheme for mangroves in southwestern Madagascar. Marine Policy, 148, p.105450. https://doi.org/10.1016/j.marpol.2022.105450.

The existence and impact of relevant incentives should be among the first options regarding financing. Critically, financial flows, including subsidies, that are harmful to nature are at least an order of magnitude greater than those that are beneficial (Koplow and Steenblik, 2022). Much can be achieved simply by reducing the impacts of these perverse incentives. Better still, to redirect such financial flows towards nature positive programmes, including the restoration of inland aquatic ecosystems for livelihoods.

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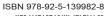
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Livelihoods-based restoration of inland aquatic ecosystems for poverty reduction, food and nutrition security and biodiversity conservation

This document provides guidance on ecosystem restoration that supports human well-being and livelihoods, addressing two important imbalances in the dialogue on ecosystem restoration: First, the over-focus on ecological objectives as the entry point to the design and implementation of ecosystem restoration. Second, the underrecognition of the importance of and opportunities for restoration of inland aquatic ecosystems. Most current general forums, literature and guidelines on ecosystem restoration emphasize ecological approaches and/or outcomes for nature. Human well-being, and more rarely livelihoods benefits, are often implied but typically not explicitly incorporated into restoration programs. The guidance here adopts a peoplecentred approach that addresses the objectives of livelihoods, poverty reduction and food and nutrition security. Ecological outcomes are seen as a tool to achieve this end and co-benefit of it. In doing so, trade-offs among winners and losers become more transparent and central, local knowledge is prioritized over scientific/technical approaches and local communities are placed central to the design and implementation of interventions. Apart from human rights, justice and equity considerations and alignment with development goals and priorities, a people-centred approach with a focus on livelihoods, poverty and food security is more likely to deliver sustainable outcomes, including for biodiversity, particularly where local communities are empowered to manage the direct use of these ecosystems for livelihoods benefits. The guidance provides a brief introduction to the topic through a set of principles, relevant conceptual frameworks, a theory of change and key considerations in designing an ecosystem restoration programme or project. The intention is, where necessary, to shift the policy approach and how practitioners use associated guidance on relevant topics. Throughout, examples from inland aquatic ecosystems in developing countries are provided to illustrate the topics. The approach significantly changes how ecosystem restoration is designed, planned, implemented, monitored, assessed and funded.





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