espa
ecosystem services
for poverty alleviation

An environment for wellbeing: Pathways out of poverty

Policy messages from the ESPA programme

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The environment's ability to support human life and wellbeing

ESPA's scientists provide detailed scientific evidence to warn that, in certain regions, the natural environment has become so degraded that it fails to provide some of the critical functions needed for human survival and wellbeing. In some localities, such as Lake Erhai in China, this can be described as ecosystem collapse; in other locations – some covering hundreds of square kilometres such as tropical deltas – the ecosystems are entering 'danger zones' where active measures are needed to avert ecological collapse and safeguard human lives. One such delta is the Ganges–Brahmaputra–Meghna delta that is home to 40 million people.

The impacts of environment-related decisions on resource-dependent people

The overarching message of ESPA's research is that policy and programmes that utilise environmental resources will inevitably carry implications for human wellbeing and may even bear hidden human costs – unless there is due assessment and care. These implications and any potential human costs must be adequately understood and explicitly addressed through open, just and democratic processes.

ESPA research has either explicitly or tacitly assumed that members of society must agree on the minimum social foundations necessary to create a 'safe and just space'[1] for living within planetary boundaries.[2,3] This means: managing environmental resources in ways that avoid high risks of irreversible environmental changes, avoiding harm to vulnerable social groups living in poverty, and working to ensure that environment and development interventions raise vulnerable people out of poverty.

ESPA research shows that the architects of development policies and programmes that access and use environmental resources are largely failing to consider how these interventions will affect society's most vulnerable and resource-dependent people. This is equally the case for policies and

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programmes that have environmental conservation as their primary goal, such as protected areas and carbon sequestration projects, as for 'development first' interventions.

Of particular importance, land-use intensification to increase yields of food and fibre has often had negative impacts on food security and incomes, particularly for the poor – and contrary to expectation. Land-use intensification is, in many cases, harming the broader set of ecosystem services that regulate the environment and maintain its health, and human wellbeing.

It is essential for decision-makers to identify – in specific localities – how services provided by the environment sustain local people's lives and wellbeing, so that these benefits are not inadvertently harmed or destroyed. ESPA's science urges decision-makers to consider the needs of society's most vulnerable and marginalised people when it comes to the design and delivery of policies and programmes based on environmental resources.

The good news is that well-designed interventions can reward local people for actions that simultaneously (a) yield environmental benefits (that accrue locally, regionally and globally across scales) and (b) increase the flows of social, cultural and economic benefits to local people.

Fundamental to this finding is ESPA's focus on 'wellbeing': the fact that local, resource-dependent people may value environmental resources differently from how external parties value them (see Box 1). There are ample decision-support and management tools and frameworks to assist decision-makers in identifying these considerations and negotiating better-informed choices. Many of these have been tested in new situations by ESPA researchers and are referenced in this summary.

By the same token, although some environment-related interventions can be shown to pose irreconcilable trade-offs, the tools and frameworks provide a basis for more robust decision-making. They do so by identifying those trade-offs explicitly – and so provide the basis for open discussion and the possibility to fairly compensate those who bear any costs.

Based on the larger body of evidence that inequity plays a role in keeping people in poverty – that is, their lack of voice in decisions over environmental resources and also lack of equity in how the benefits of those resources are distributed – ESPA has shone the spotlight on the need for equity and rights-based approaches. ESPA has developed decision-support tools and management frameworks to support effective participation in decision-making by those who rely on the environment.

Given the critical status of many environmental resources in many countries and subnational regions studied by ESPA, it is clear that the job of addressing these issues is challenging and complex and that the stakes are high. There is no room for complacency. There is a need to invest in monitoring ecological health and human wellbeing on an ongoing basis, and to learn from management successes and mistakes.

Recommendations for well-informed and fair decisions over environmental resources

1. **Decision-makers must identify the 'hidden' costs to the poorest in society**, and the trade-offs in programmes and policies that access and use environmental resources, so that the most vulnerable people are not inadvertently left worse off. Environmental and social impact assessments for development interventions – and for environmental conservation programmes – are frequently inadequate. Assessments must capture local people's dependencies on the natural environment. They must capture the possible impacts when local people's access to and use of environmental resources are constrained. By making these costs explicit, projects and programmes may be rejected if they are deemed to cause harm to local people, or they may be completely redesigned in order to benefit poor people in the local area effectively.
2. **Methods for joint discovery and knowledge creation can help identify resource dependencies and trade-offs**, especially in local and regional processes (although proxies may be found at global scales of decision-making). To develop sound understanding of the links between human and ecological systems requires a marriage of scientific knowledge with ground-truthed, more localised knowledge from the people who are affected by environmental decisions. Ideally, 'consumers' of the knowledge base on which decisions are made become active co-producers of this shared knowledge.

3. **Having identified the trade-offs, decision-makers must deliberately manage these interventions to avoid harm and to benefit the poorest**. While all solutions need to be nationally and locally relevant, ESPA research nonetheless highlights a set of universally applicable core principles for sound environmental governance and management. Applying these principles can ensure that costs and trade-offs are identified and managed in a way that does no harm and helps the poorest.
4. The core principles for designing and managing the use of environmental resources are as follows.
    i. **Recognising and granting rights**: Affected local people need statutory rights to access, manage and govern environmental resources – among these, officially recognised tenure rights are among the most important. Inequitable tenure rights among women and men remain one of the most persistent injustices, although inequitable rights among all social groups also need to be scrutinised and addressed.
    ii. **Accountability** to affected people, across scales of governance: Policies and programmes should be designed with effective mechanisms in place to ensure that actors working across scales (local, national and global) of environmental extraction and use are accountable to affected local people.
    iii. **Transparency**: The intended outcomes and beneficiaries of development and conservation interventions should be communicated transparently to all – and should be monitored and communicated on a regular basis.
    iv. **Participation**: Socially marginalised groups should be empowered and actively supported to participate in environmental decision-making.
    v. **Capacity development**: It is not only the local people affected by the use of environmental resources who may need support in order to participate meaningfully in programme design and implementation. Programme managers themselves often need support and training to build the skills necessary to run effective, participatory and inclusive processes – and they need support to be ecologically and socially 'literate'.
    vi. **Recognising and rewarding local stewardship**: Local people's stewardship of environmental resources and their contribution to flows of ecosystem services and goods – in their many forms – must be adequately recognised early in the decision-making process and sufficiently rewarded. Conditional transfers of cash and in-kind resources are one way of achieving this but may need to be augmented by other forms of recognition and reward.
    vii. **Adaptive processes and learning**: As the physical sustainability of resource use is measured and monitored over time, so the social impacts must be measured and monitored. We live in a dynamic world of constant change: of local places that change continuously; of national, regional and global events and pressures that have local consequences. This means that the institutional and governance arrangements for use of and access to environmental resources must be under frequent review, including who benefits, and who may be harmed by the arrangements.

This policy summary explores – through short examples and references to the ESPA literature – exactly how these principles have been successfully put into practice and how decision-makers around the world can adopt them, to ensure that the use of environmental resources is right for the global environment and for locally affected people, including the poorest.

PART I: INTRODUCTION

Introduction

About ESPA

The Ecosystem Services for Poverty Alleviation (ESPA) programme is a global, interdisciplinary research programme that aims to give decision-makers and natural resource users the evidence they need for more sustainable ecosystem management and effective poverty reduction. Ecosystem services support human society: covering everything from freshwater flows and soil quality to fisheries productivity and climate regulation – and including cultural and spiritual values.

The Government of the United Kingdom created the ESPA research programme in 2010. It has taken on tough questions, such as: Do ecosystem services provide safety nets for people in poverty? Can ecosystem services help vulnerable people to diversify their livelihood options and security, and to enhance other aspects of their physical and mental wellbeing? How should environmental goods and services be prioritised in development, and how could they contribute to sustainable growth in developing countries and emerging economies? Are there local and regional biophysical limits and thresholds that cannot be avoided and how might they be identified? Now, eight years on, ESPA's research is more timely and relevant than ever.

Impactful research for a rapidly changing world

As the ESPA programme draws to a close in 2018, we can look back and celebrate the substantial decreases in global poverty over the past two decades: between 1990 and 2011, almost a billion people escaped extreme poverty.[4] Yet, as governments take measures to address the Sustainable Development Goals, including the first goal – to end extreme poverty – the reality is that poverty persists in deeply entrenched pockets. It is hard to shift, requiring many policy and programme interventions. Inequality has played a role in trapping the remaining poor and could jeopardise efforts to wipe out poverty.[5,6,7]

ESPA research shines a spotlight on equity issues in the access to and use of environmental resources (see Box 1).

ESPA research has looked at the multiple dimensions of human poverty and wellbeing in the changing context since the Millennium Ecosystem Assessment[8] was published. What has changed in this external context? Although poverty was conventionally measured by households' incomes and means of livelihood, more sophisticated measures have been adopted – such as the Human Development Index[9] and more recently the Multidimensional Poverty Index[10] – which reflect data on education, health and other aspects of people's living standards. ESPA studies have used these measures and even more sophisticated ones (see Box 2).

The continuing growth of the world's human population, shifts in age distribution, household size, wealth distribution, consumption, and patterns of movement, including planned and unplanned migration, all influence the interactions between people and the environmental resources on which they depend.[11] Ecosystem management has the potential to either buffer or amplify the welfare consequences of population changes and migration, but the most vulnerable groups of people are most likely to be losers, and so deserve particular attention in planning and policy processes.[12] Meanwhile, more than half of the world's population lives in urban areas and continues to move from rural to urban areas, overall. Urban areas place heavy demands on nearby ecosystems as well as more distant ones, and have the potential to utilise environmental resources more effectively and imaginatively, especially for the benefit of the poorest residents and in peri-urban areas. The flows and management of environmental resources across the rural to urban landscape and across scales is an emergent area of scientific understanding, which ESPA research has just begun to illuminate.[13]

Box 1: Equity and justice are environmental issues

An environmental justice framework encompassing recognition, procedure and distributional aspects is a broad approach to understanding diverse perspectives on environmental management and change. It highlights how the costs and benefits of environmental decisions are felt across society, and how different social groups value the environment. The approach is well suited to illuminating the nature and extent of trade-offs, and to bringing forward the views of poor and marginalised stakeholders, who are often under-represented through standard environmental management frameworks.

Although equity has become more frequently mentioned in policies, it is seldom achieved in practice, particularly for the poorest members of communities and for cultural minorities. The ESPA programme and others have made some progress in developing principles and describing characteristics of equitable governance systems, which may highlight the 'hidden costs' of environmental interventions and help resolve trade-offs.[14]

Box 2: A focus on wellbeing

In the past decade, there has been an "explosion of initiatives to conceptualise and measure human wellbeing and to put it into practice in academia and policy".[15] ESPA science emphasises that social groups (women and men, youth and elders, ethnic groups, rich and poor) use and value environmental resources differently; this needs to be recognised in decision-making. Wellbeing is a dynamic and multidimensional phenomenon incorporating objective, subjective and relational aspects.[16] A Global Person-Generated Index of wellbeing is one method applied by ESPA researchers to allow community members to express how they feel they have been affected by environmental conservation programmes – in their own terms and using multiple dimensions of wellbeing. It was used in Madagascar, where participants were asked to identify the five most important domains for their quality of life, to evaluate their experience in each one and the relative importance of the five domains. Half of respondents said that conservation programmes had had neither a positive nor negative impact on their wellbeing.[17]

The structure of the world economy continues to evolve rapidly. This is especially the case in developing countries, where ESPA's research has been focused. Natural resources are increasingly coming under pressure. Debates about the reuse and recycling – and the substitution – of finite natural resources have gathered pace since ESPA was founded. A truly 'circular economy' is still far from being realised but businesses, governments, communities and households are making the first important steps in this direction.

There is a large-scale shift towards the use of renewable natural resources such as sunlight, wave and geothermal sources for energy – driven by recognition of the dangerous consequences of greenhouse gas emissions from fossil fuels. Recent and rapid cost declines for electricity from solar photovoltaics, offshore wind and concentrating solar power are making these renewable energy alternatives fully competitive.[18] Vastly more efficient industrial processes,[19] including 'Fourth Industrial Revolution' technologies[20] and new manufacturing technologies from waste and recycled goods, create the possibility to reduce pollution and curb the use of raw materials.

Notwithstanding emerging technologies and innovations to break the correlation between economic growth and use of materials, humankind still depends directly and indirectly on ecosystems for food and water and for the bulk of our shelter and other material needs, and therefore our existence and wellbeing. The importance of these 'provisioning services' provided by the natural environment is indisputable.

What is more, healthy ecosystems carry out important regulating functions, such as regulating hazards (e.g. floods, fire, heat waves, pests) and the stocks of carbon and other elements necessary for human and other species' survival. Regulating services are often lost – and often as a result of intensifying land use to provide food and fibre. It is difficult and costly to reverse such changes as those in the climate and water quality, which have heavy impacts on society's poorest.

Figure 1 shows how attainment of many of the Sustainable Development Goals depends on a healthy, well-functioning natural environment.

> **The environment's ability to regulate hazards, such as floods, fires and pests, is often lost as a result of land-use intensification to provide goods such as food and fibre.**

About this report

ESPA science provides a rich, empirical evidence base on the relationships between human wellbeing and the natural environment. This report begins by providing a summary of the dynamic physical state of our environment and how it responds to ecological and social processes. This review indicates how decision-makers can think about thresholds and tipping points – and where environmental conservation, restoration and remediation are needed.

We discuss development programmes reliant on environmental resources (such as agriculture), environmental conservation and restoration programmes (such as protected areas establishment) and programmes that combine both environmental and development goals (such as community forestry schemes, urban waste water management and agriculture) – see Box 3 for examples.

FIGURE 1: Interactions and trade-offs among outcomes for human wellbeing

Stocks and flows of ecosystem services

- Climate regulation
- Diverse genetic resources and species interactions
- Disease regulation
- Water quantity
- Water quality
- Shelter
- Food products
- Cultural, aesthetic and spiritual assets

Supporting ecosystem services
soil formation, nutrient formation, primary production

Achievement of many Sustainable Development Goals depends directly on these resources and also influences them

- End of poverty
- Zero hunger
- Good health and wellbeing
- Quality education
- Gender equality
- Clean water
- Affordable and clean energy
- Sustainable cities
- A habitable climate
- Marine ecosystems
- Life on land
- Peace, justice and strong institutions

How do we ensure that benefits flowing to environmental resource users in one place or social group do not impose harmful costs on others?

ESPA highlights **core principles** of good governance and **tools and management frameworks** to help decision-makers

Box 3: Development and environment interventions that rely directly on access to and use of environmental resources

Examples of development interventions

- Construction of dams, e.g. for hydropower and irrigation
- Agriculture programmes, including for food security and commodity production
- Commercial forestry schemes, e.g. timber production
- Freshwater access and sanitation schemes
- Bioenergy and biofuel development programmes, e.g. sugarcane, jatropha, palm oil, crop residues
- Wetland and urban drainage
- Marine and coastal fisheries
- Land-use changes

Examples of environmental conservation interventions

- Afforestation and reforestation schemes, including for carbon storage and sequestration, and biodiversity conservation
- Protected areas, including wildlife sanctuaries and national parks
- Coastal protection and management schemes
- Habitat restoration
- Soil and dune restoration

Box 4: 'Ecosystem services'

ESPA was created to investigate 'ecosystem services' and their relationship with poverty alleviation. It may surprise readers that this summary of ESPA's research findings talks more about 'environmental resources' than about 'ecosystem services'. That is because the recommendations in this report are targeted specifically to decision-makers in government, business, civil society organisations and society who are less familiar with the scientific terminology around ecosystem services. We have chosen their language. The term 'environmental resources' maps to typical government and business departments – such as environment agencies and corporate social responsibility teams – who we hope will act as ambassadors for ESPA's results and seek to mainstream the programme's key messages into their organisations and policies.

We present the main types of ecosystem services in Figure 1, which shows how: ecosystem services shape human development; human development in turn creates pressures and responses in the natural environment; and these environmental changes, in turn, instigate further human responses. The ESPA programme has influenced, and has been influenced by, a 'kaleidoscopic' evolution of frameworks that seek to depict these interactive, give-and-take relationships between human beings and the natural environment.[21] It is safe to say that one of the most important developments in the way scientists think about and approach ecosystem frameworks is a transition away from a mostly biophysical approach that emphasises the supply of ecosystem service provision (and so is focused on the links between biodiversity, ecosystem functions and services), to a plethora of frameworks that emphasise the human demand for and production of ecosystem services and many interactions and feedbacks. Recent scholarship and practical approaches have also recognised the plurality of values that different social groups place on the environment, and the role of power and justice via institutions and governance systems as the filter through which ecosystem services create winners and losers.[22]

PART II: UNDERSTANDING HOW PEOPLE AND THE ENVIRONMENT INTERACT

Understanding how people and the environment interact

The science of environmental and social systems – what it means for human wellbeing and a healthy environment in the long term

In some places, the natural environment has become so degraded that it fails to provide critical functions needed for human survival and wellbeing; in other places, it is entering a 'danger zone' in which there is a high risk of irreversible ecological changes occurring.

In 2005, the Millennium Ecosystem Assessment warned readers that "Over the past 50 years, humans have changed ecosystems more rapidly and extensively than in any comparable period of time in human history, largely to meet rapidly growing demands for food, fresh water, timber, fibre, and fuel. This has resulted in a substantial and largely irreversible loss in the diversity of life on Earth. The changes that have been made to ecosystems have contributed to substantial net gains in human well-being and economic development, but these gains have been achieved at growing costs in the form of the degradation of many ecosystem services, increased risks of nonlinear changes, and the exacerbation of poverty for some groups of people."[23] The Assessment also found that "some systems have eroded their capacity to provide services on a regional basis, such as inland waters, forests and drylands"[24] and "the increased efficiency of use of many ecosystem services has been offset by increases in the absolute amounts of consumption of services, giving rise to serious concerns about the sustainability of their supply."[25]

ESPA has not produced a comprehensive scientific assessment equal to the Millennium Ecosystem Assessment but, instead, has (during 2010–2018) supported a set of leading-edge scientific research projects to test and illuminate the dependencies of human wellbeing on environmental resources. ESPA studies look at the drivers of environmental loss and replenishment, the human consequences of these dynamics, and the institutions and governance that help to shape them.

The relationship between environmental degradation and human wellbeing is not a simple linear relationship.[26] Sudden and unpredictable changes in ecosystem services include the collapse of fisheries from overfishing, rapid soil salinisation caused by shrimp farming, and the switch between clear and turbid lake water caused by gradual increases in nutrient-rich run-off.[27] Scientific research has shown that when ecological limits such as these examples are transgressed, then the natural environment can reach unprecedented, irreversible and often undesirable states.[28] The concept of a 'safe operating space' describes the conditions within which a system should remain to avoid crossing these thresholds of irreversible change – or 'tipping points'.

Caribbean coral reefs are said to have passed such a threshold – and to have become rapidly and unexpectedly encrusted with algae. Here, nutrient loading (e.g. through agricultural run-off) provided the conditions for algae to grow on the reefs. At first, fish ate the algae and kept it in check. However, decades of over-fishing reduced fish numbers and meant that fish could no longer perform this function. Scientists were surprised when a sea urchin, *Diadema antillarum*, moved into the fish's ecological niche and ate the algae growing on the coral reefs instead. The coral reefs seemed to be faring well, but their fortunes were short-lived. Next, a disease spread throughout the *Diadema antillarum* population, killing most of the urchins. Algal growth suddenly flourished again on the coral reefs, creating an ecological tipping point, which will be difficult and costly to reverse – that is, if it is even possible to reverse.[29]

Tipping points are typified by the large impacts of very small changes which require significant investment to reverse. Simply returning the driver of the change back to its previous levels may not be enough to recreate the former state due to internal positive feedback effects.[30]

An example of where an ecological system has tipped is the Erhai catchment in China. Within a matter of months in 2001, the Erhai lake's aquatic ecosystem passed a critical transition from relatively clear, healthy water to a turbid eutrophic (oxygen-starved) state. Today, despite implementation of measures to reduce nutrient pollution from farming and sewage plants, the lake shows no evidence of returning back to its previous state. The water quality has passed across a physical boundary into the 'danger' zone.[31] ESPA research demonstrates how, in Erhai and nearby Shucheng catchments, exploiting environmental resources for farming supported many micro- and macro-level measures of development in the past, such as education and health care. However, authorities in these catchments have not yet managed to extend universal access to piped water, energy and modern sanitation, and with freshwater resources now in such a dire condition, it will be a huge challenge to meet these remaining development needs.[32]

This study demonstrates trade-offs between recent successful poverty alleviation and acute environmental degradation. It is a negative relationship, by which some elements of poverty alleviation (food) are achieved in the short term at the expense of other elements of wellbeing (human health) and the longer-term health of the environment.

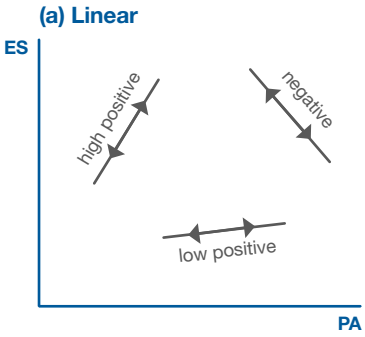
Another study, in coastal Bangladesh, found that the localised impacts of global environmental change (in this case, climate change and associated sea level rise) is having profound impacts on social–ecological systems and people's ability to live and thrive in these places. The investigation by the ESPA Deltas team in nine coastal districts of Bangladesh measured water salinity in groundwater – as affected by sea-water intrusion – and the blood pressure of local people. It found that 80% of residents relied on drinking from groundwater sources, that high blood pressure (prehypertension and hypertension) was significantly associated with saline drinking water, and that almost half of the overall population in these areas is either prehypertensive or hypertensive. This is high: from 21% to as much as 60% higher than the expected incidence of high blood pressure based on Bangladesh's national statistics. Residents aged over 35 years old and women are particularly vulnerable, and show the worst health impacts. The study also found that the population's salt intake and blood pressure are likely to increase in the coming years, foretelling much individual suffering as well as a collective impact on the public health system. It could be said that this delta system is moving uncontrollably towards passing thresholds into danger zones, where people and ecological systems may lack the resilience to withstand further changes in the climate or other ecological and social pressures.[33]

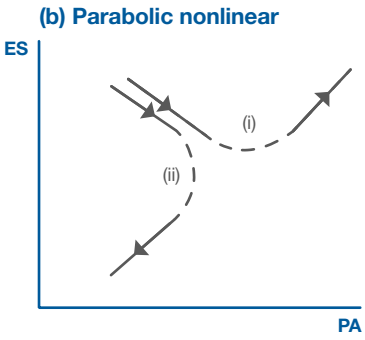
How do decision-makers know when an ecosystem is reaching a critical threshold or tipping point? It has been very difficult to develop models to simulate these processes adequately and to capture multiple 'feedback loops' among different types of environmental, social and economic change. Simulating future changes in social–ecological systems in ways that capture thresholds has been particularly challenging.[34]

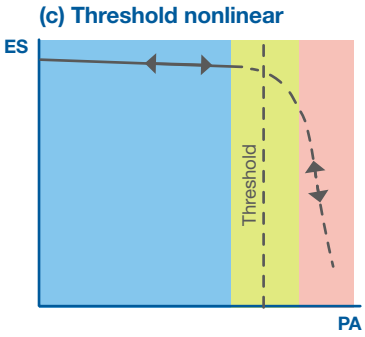
ESPA research has highlighted the notions both of 'elasticity' between poverty alleviation and environmental outcomes, and of breaching thresholds, both of which are illustrated in Box 5.

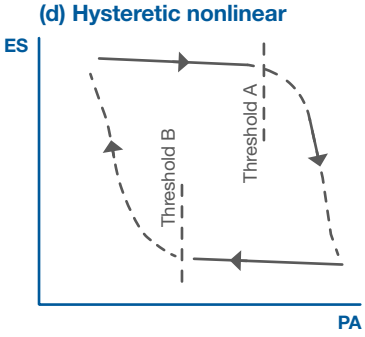
In practical terms, there are steps that policy-makers can take to monitor the interaction of social and ecological systems and their proximity to 'tipping points' and danger zones. Policy-makers can invest in research that measures indicators of environmental health and human wellbeing over decades in order

Box 5: Relationships between poverty alleviation and ecosystem services









Many theoretical and empirical relationships between human wellbeing or poverty alleviation and the quality or abundance of ecosystem services have been proposed by ESPA researchers and others. The ESPA evidence base provides conclusions about the quality and functioning of certain regional and subnational ecosystems – and how poverty and wellbeing are experienced there. However, there is not a single overarching conclusion about the relationship between wellbeing and ecosystem services over time: this is an area that calls for more research.

In the graphs presented here, ecosystem services may represent aggregated services but, more realistically, a sub-set of provisioning, regulating, supporting or cultural services. Graph (a) shows various **linear** relationships between ecosystem services (ES) and poverty alleviation (PA), and possible directions and elasticities (or strengths) of these direct relationships. Negative elasticity describes situations where poverty alleviation efforts succeed even as ecosystem services decline; positive elasticity describes situations where poverty increases as ecosystem services improve. Elasticity is either 'low' when social and ecological systems are weakly related or 'highly elastic' when the relationship is strong. Graph (b) is a '**parabolic nonlinear**' relationship between ecosystem services and poverty alleviation. On this trajectory, which is often gradual: (i) regulating ecosystem services (such as water quality) decline with agricultural intensification and then improve as poverty is alleviated and regulatory frameworks improve; (ii) activities to alleviate poverty, such as logging, cause regulating ecosystem services (e.g. forest cover, biodiversity) to decline, which eventually has negative effects on provisioning ecosystem services (e.g. forest products) and so increases poverty; at this stage, regional resource exploitation leads to growing inequalities in wellbeing. Graph (c) is a '**threshold nonlinear**' relationship between ecosystem services and poverty alleviation, where crossing a threshold causes a relatively rapid decline in ecosystem services, for example the loss of rice yield (provisioning ecosystem services) as investment in larger shrimp farms causes widespread soil salinisation. The example uses the definition of 'safe, cautionary and dangerous operating spaces' (blue, green and pink), which in theory may be reversible. Graph (d) is a '**hysteretic nonlinear**' relationship between ecosystem services and poverty alleviation, where – in contrast to (c) – threshold responses between ecosystem services and poverty alleviation may be irreversible or time-lagged, for example the loss of fish stocks (provisioning ecosystem services) as technological investment in fish catch methods transgresses threshold A; fish stock recovery requires fishing efforts to be reversed beyond threshold A to threshold B, with losses of income or livelihoods.[35]

to generate the data that makes it possible for rich analysis of long-term trends about the relationships between these variables, and the feedbacks among them. Investing in robust data collection and research will enable scientists and policy-makers to work together to assess where certain ecosystems are on the curve (Box 5) and how close the ecosystem is to reaching an ecological threshold. Policy-makers can also work in partnership with scientists to model social–ecological interactions, including using some of the approaches and building on some of the insights that ESPA projects have revealed. A general conclusion is that such modelling exercises can be repeated and refined as users learn by doing, and the models can provide useful guidance rather than predictions.

Policy-makers can recognise that development pathways are constantly evolving. Policy and practice can be understood as requiring a constant 'nudging' of development trajectories in directions that don't close options, avoid undesirable ones, and stay away from known or suspected thresholds – learning and adapting along the way (see 'Learning and adapting', page 29).[36]

Beyond simple definitions of poverty and wellbeing – taking a fair and just approach

One of the most important findings of ESPA research is the need to recognise different values. When it comes to identifying development activities, whose view and judgment is seen as the most valid? How are the different opinions of different stakeholder groups weighed and resolved?

ESPA research has highlighted, for instance, that the notion of what it means to be 'poor' – and also its opposite, what it means to feel well and fulfilled – differ according to culture and circumstance. Therefore, it is important for people impacted by decisions over environmental resources to articulate **how** different outcomes will affect them.[37,38]

Understanding wellbeing in this more nuanced and differentiated way – as ESPA research has done – highlights inevitable trade-offs over the access to and use of environmental resources. Approaches to decision-making and governance based on environmental justice help with the value judgements necessary to resolve these trade-offs. For instance, participation in decision-making over access to and use of environmental resources is important because it brings to light what is important to affected people. When people's values are recognised and their concerns addressed (or mediated), then they are more likely to support the outcomes of the decision process. The outcomes should be fairer and better sustained. Part III investigates core principles of good governance in more detail, with ESPA examples.

Existing frameworks to measure human wellbeing do not adequately capture the highly context-dependent indicators of human wellbeing used by rural communities that rely on ecosystems for their primary source of subsistence. These communities frequently place greater emphasis on the intrinsic value of natural resources (e.g. ritual, symbolic, cultural, identity). Studies that take a more comprehensive and non-utilitarian approach can contribute to the agenda by privileging local views and understandings of ecosystem services (particularly those of the most vulnerable).[39]

Development policies and programmes – identifying the hidden costs and potential for resource-dependent people

Many development policies and programmes that are based on the extraction and use of environmental resources are being designed and implemented without adequate recognition of who currently stewards and uses environmental flows, who will be affected by development interventions, and how.

> **Some of ESPA's research has highlighted environmental protection initiatives that engender different benefits or disadvantages for women and men.**

ESPA research highlights the risks of oversimplifying our understanding of human–environment relationships and the importance of assessing socially disaggregated outcomes. This has implications for the design of interventions that are intended to alleviate poverty.[40] There is abundant evidence on how development programmes that are based on natural resource extraction and use are failing to achieve their poverty reduction goals – or are even inadvertently disadvantaging the poorest people. ESPA research provides further evidence from its portfolio.

Changing agricultural policies in Rwanda have affected local people's livelihoods and wellbeing. An ESPA study shows that lower-income households are struggling to benefit from policies that back intensive monocultures, compared to mixed-crop farming systems that previously dominated.[41]

The charcoal industry is among the most important semi-formal economic sectors in sub-Saharan Africa and a key cash income source for local households who produce it. There is a debate around the role of charcoal production in alleviating rural poverty. ESPA research in southern Mozambique found that charcoal production is failing to lift its producers out of acute poverty – when poverty is measured by a composite of nine indicators: sanitation, water security, mortality of children under 5, access to equitable health care, formal education, food security, access to services, associations and credit, assets owned and housing.[42]

Jatropha-based biofuels have attracted private sector and government interest in Malawi in the past decade, as part of a strategy to reduce poverty and stimulate rural development, but these hopes are not yet fulfilled. ESPA research has found that jatropha production in Malawi has minimal impact on food security and poverty alleviation, and the situation is unlikely to change unless high-yielding plant varieties are tested in real conditions and market options improve. By contrast, the researchers found that food security improved and overall poverty decreased for the rural poor involved in sugarcane production (another biofuel crop) – although the environmental impacts of sugarcane depend on the location and must be assessed and tackled on a case by case basis.[43] As with the charcoal research, a multidimensional poverty index was used to assess the effects on local people's lives.

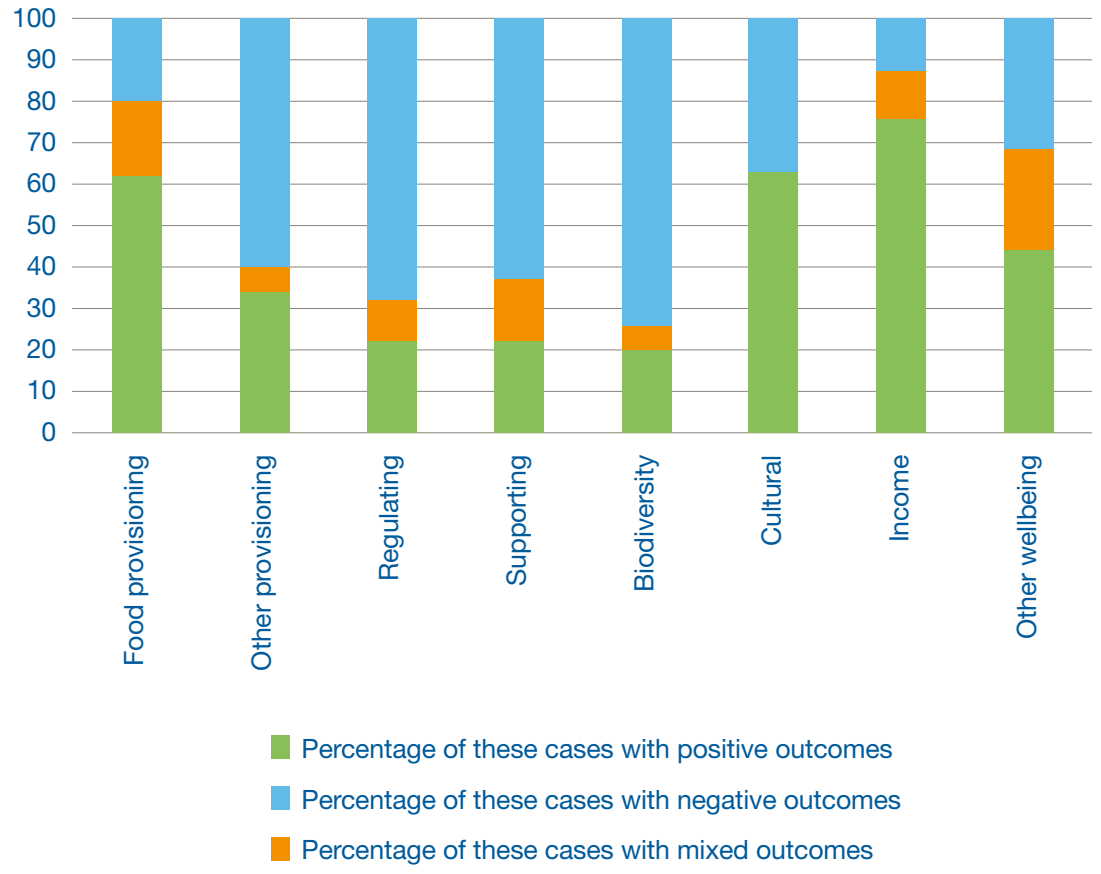
Land-use intensification is disrupting environmental resources – and requires urgent scrutiny as a development strategy

There are seemingly compelling reasons to intensify land-based production systems, such as agriculture, and yet the benefits of higher productivity have too often been accompanied by massive and detrimental contributions to global, regional and local environmental change.[44] By 2050, there will be

an estimated 9 billion people on the planet, potentially requiring a massive increase in global food production. Meanwhile, there is increasing competition for land arising from other urgent global and local challenges, including the expansion of protected areas to help conserve biodiversity and the rise of bioenergy crops to help tackle climate change. Policy-makers have focused predominantly on the potential to increase agricultural yields through intensification.

An ESPA review of the most recent research in this area revealed that land-use intensification in fact poses an increasing threat to future food production because it is degrading ecosystems so profoundly: through accelerated soil erosion, loss of biodiversity, pest damage and changes to nitrogen and phosphorous cycles. Intensification has also led to over-extraction of water and pollution of water sources, while agriculture already accounts for 70% of freshwater extraction and demand is predicted to increase by 70–90% by 2050. The ESPA review finds that local food and income are most often increased as a result of land-use intensification efforts, but even then, they sometimes decrease (see Figure 2). On the other hand, some indicators of sustainability that are widely recognised as important outcomes of land use (e.g. water purification, water regulation) are infrequently researched and, when they are, record negative outcomes in the majority of cases.

Figure 2. Proportion of land-use intensification studies reporting positive and negative outcomes for different categories of ecosystem services and human wellbeing[45]



Environmental conservation policies and programmes – hidden costs and opportunities

The architects of environmental conservation policies and programmes are also, in many cases, failing to recognise the complex relationships between people and the environment, including between people and biodiversity. As a result, many environment programmes are inadvertently making local poverty worse.

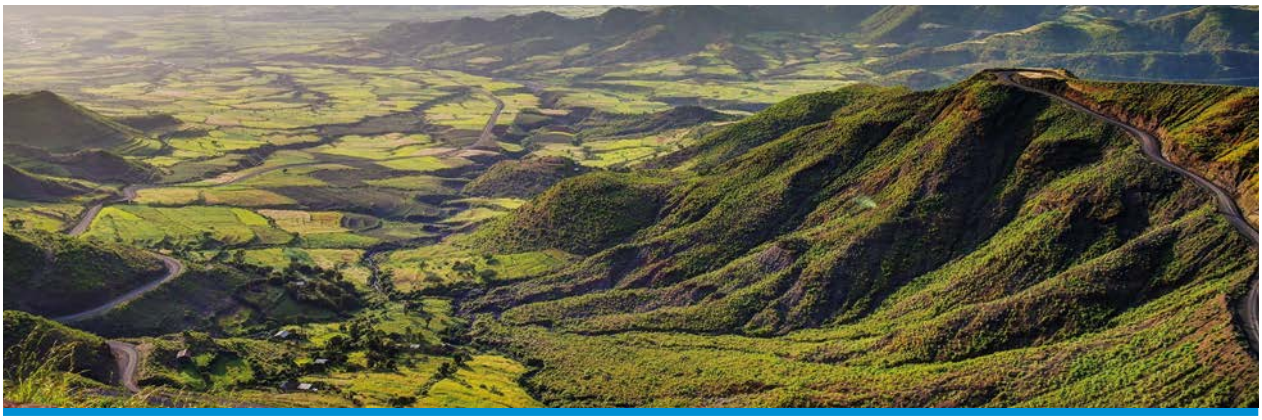
Because these relationships are not clearly identified, and some of the costs to local people are hidden, programmes are being poorly designed – to the detriment of development and environmental goals. ESPA research has found major instances of environmental programmes disadvantaging the poorest local people. Programmes for increased forest conservation to protect the global climate, programmes to ensure provision of water to downstream users and biodiversity conservation initiatives, including those intended to protect species with high tourism potential, have all been found to commonly lead to short-term losses to local populations in the availability of food, fuel and other basic needs from the environment, and/or increased prevalence of harm to local people such as farmers suffering from crop-raiding animals.[46]

Better work up front to assess impacts, identify and avoid harm, and manage trade-offs will pay dividends for people and the natural environment. While the Millennium Ecosystem Assessment identified inequity in the ways in which environmental resources are accessed and transformed into human wellbeing,[47] ESPA research details such inequities, **particularly** those resulting from environmental conservation initiatives.[48]

A key problem has been that much research on the impacts of conservation interventions does not disaggregate social data adequately to identify precisely who benefits and who loses.[49] For example, a given governance strategy may raise average incomes, but these gains may serve to make the relatively well-off richer while excluding the poorest and most vulnerable.[50]

ESPA research has highlighted instances where environmental policies and programmes failed to benefit poor and marginalised households, or further harmed them, and so ultimately led local people to respond in ways that undermined the intended environmental goals. A study of who benefits from community forestry found that such schemes are more likely to generate positive change at community level rather than directly benefitting poor and marginalised households.[51]

Some of ESPA's research has highlighted environmental protection initiatives that engender different benefits or disadvantages for women and men. For instance, programmes to reduce the use of illegal fishing gear on the Kenyan coast may improve the number of large expensive fish but have a negative impact on the



wellbeing of women who rely on selling smaller fish.[52] A different study found that men and women have very different expectations of their involvement with conservancies (wildlife protection areas) around the Maasai Mara National Reserve in Kenya. Women tended to favour membership in a conservancy and they valued wage income significantly less than men. Overall, the study found that community members perceived engagement with conservancies to be positive, as long as they were able to retain some land for other purposes – and that great care is necessary to consult individuals on their preferences, to avoid harm.[53] Box 6 describes how violent conflicts have arisen from Tanzanian wildlife conservation initiatives.

In addition, more transparent, participatory governance and management of environmental resources, as explored in the next section of this report, can unlock human capital. Such processes could unlock the talents of natural resource users, including their relevant local knowledge, and could motivate them to work in partnership with others for a more sustainable collective future.

Incentivising particular land-use and land management strategies may give rise to new types of trade-offs because altering socio-environmental interactions directly affects local resource users, potentially exacerbating the vulnerability of some members of the community.[54]

Box 6: Realising the potential of Tanzania's wildlife management areas

Tanzania's Community Wildlife Management Areas (CWMAs) – originally called Wildlife Management Areas – were intended to benefit both people and wildlife. However, for their first two decades, CWMAs have been characterised by land conflict, wildlife damage to people and crops, lack of tourism potential and high administration costs, among other negative impacts.

Fundamental elements of the wildlife management area design – i.e. their governance and management arrangements and the way budgets are administered and financial benefits derived – appear to be flawed and so undermine these joint poverty alleviation–environmental goals. For instance, village income from CWMAs is often insufficient to offset or compensate for wildlife damage to crops and livestock or the opportunity costs of CWMAs borne by local communities. Retention of parts of the revenue by central government and CWMA administration costs erode tourism revenues. ESPA researchers have engaged with wildlife area managers and policy-makers to recommend that the 'rules of the game' should be rewritten. Specific recommendations include:

- "Rethinking the division of CWMA revenues could make them more financially and socially viable.
- Giving CWMA villagers sustainable access to key natural resources will benefit rural livelihood security and reduce the potential for conflict.
- Revenue sharing between CWMA villages should be based on negotiations between the villages, considering costs borne related to human-wildlife conflict, tourism investments, and land surrendered to CWMA.
- Fair and transparent consultation and planning for new CWMAs will improve the likelihood of community buy-in.
- Empowering villages to make changes to CWMA plans will make CWMAs more legitimate, and so more sustainable."[55]

Understanding the interactions among society and environment better, and developing richer assessments that identify social costs and support policy-making

ESPA science has demonstrated how smarter assessments can bring to the surface both the hidden costs and the hidden potentials of resource-dependent peoples in both development interventions and environmental conservation policies and programmes. As well as demonstrating how multidimensional poverty indices can be used effectively (above), ESPA has also shown that integrated social–ecological modelling tools are useful as part of an open, participatory decision-making process.

ESPA scientists have charted how even small delays in reducing pressures on environmental systems may result in "catastrophic changes if it allows ecosystems to reach tipping points, where their characteristics and functions fundamentally change."[56] Given current technologies and monitoring systems, it is likely that scientists will be too late to detect an imminent tipping point, if at all, before an ecosystem is "committed to large shifts in state".[57] ESPA projects trialled research using smaller (e.g. regional) scale social and ecological processes as a way to conceptualise complex, global socioecological systems and concluded that such hybrid models linking human and ecological systems can be developed – and indeed, offer hope for supporting radical policies to address environmental crises.[58]

ESPA projects looked at practical ways that decision-makers can get to grips with social–economic–environmental complexity, and understand the interactions as a guide to better decisions – sometimes by applying existing approaches in new situations or adapting them to modern pressures. The Driver–Pressure–State–Impact–Response (DPSIR) is one such framework. Although first developed almost 20 years ago, ESPA researchers described how the framework can be applied in an iterative way to understand interactions among different activities and pressures in a continual cycle of learning, rather than in a linear fashion.[59] Driving forces, including socioeconomic and environmental variables, exert pressures on ecological systems. These pressures cause changes in the state of a system with impacts on individuals and communities (people or other species) that had depended on the system. These impacts cause responses, which in turn affect the driving forces on the system.

The ESPA Deltas team developed an integrated framework that describes the many complex links and drivers between the Ganges–Brahmaputra–Meghna delta environment and the wellbeing of the delta's population (see Box 7). In this vast coastal region, models show an increase in monsoonal and coastal flooding; salinity has been statistically associated with poverty and migration is often not an option for the very poor, who may be left behind. ESPA researchers have promoted collaboration between scientists and policy-makers to establish 'early warning' indicators for ecosystems, to sound the alert when an ecological threshold or tipping point may be drawing closer, and also highlighted the importance of taking precautionary measures to avert ecological damage that brings social and ecological systems nearer to unmanageable tipping points.[60]

Ecosystem service modelling tools can provide decision-makers with information on ecosystem services flows to guide certain decisions, even when the data measured are inadequate. These outputs may prove valuable in addressing questions on changing land use, valuing natural capital, and analysing co-benefits and trade-offs of different policies or activities. Because more than 80 fast-evolving ecosystem service models or assessment tools are available, technical advisors can benefit from guidance on the types of models available and considerations in choosing the models best-suited for specific policy questions. The 2013–2016 WISER (Which Ecosystem Service Models Best Capture the Needs of the Rural Poor?) project, for instance, assessed four ecosystem service modelling tools in sub-Saharan Africa and provided a general assessment of their utility (see Box 8).

Box 7: Interdisciplinary modelling for pro-poor policy-making: Experience from Bangladesh

The ESPA Deltas team undertook an ambitious, interdisciplinary study to understand the ecosystems of coastal Bangladesh and the lives of the millions of people who benefit from them. A key aim was to make the findings available to decision-makers who are seeking to protect and improve the livelihoods and wellbeing of the people who live in this dynamic delta environment. The project's many findings have been integrated into a sophisticated model, the Delta Dynamic Integrated Emulator Model (ΔDIEM).

The researchers collected and analysed socioeconomic data, including an innovative household survey. This ran in parallel to a major effort to analyse and simulate a range of biophysical and socioeconomic processes, including sedimentary, morphodynamic (landscape) and hydrological processes. Incorporating stakeholder views and an understanding of how legal, institutional and policy frameworks connect ecosystem services and poverty alleviation was fundamental to the team's work.

From this broad range of emerging knowledge, ESPA Deltas developed an integrated framework that describes the links and drivers between the Ganges–Brahmaputra–Meghna delta environment, the ecosystem services it supports, and the poverty, health and livelihoods of the delta's population. In particular, the team was interested in who would benefit from the different pathways offered by different development interventions, as well as the integrity and future of the ecosystems themselves.

The ΔDIEM is distinct in linking biophysical, socioeconomic and governance processes to consider a range of plausible futures. Given a particular development trajectory or intervention, it can assess the resulting range of impacts of change over time on the livelihoods and wellbeing of the people of the Ganges–Brahmaputra–Meghna delta, from a regional-level scale down to the lowest administrative tier (Union level, some 20,000 people), and for every year up to 2050 (2100 for biophysical change only). It can consider a wide range of environmental changes, natural hazards and climate change, and policy interventions, in various permutations. The ΔDIEM is currently being used to test the potential interventions identified by the Planning Commission of the Government of Bangladesh in line with the aims of the Bangladesh Delta Plan 2100, such as making a sea wall higher and/or planting mangrove strips. The researchers took account of stakeholder priorities and knowledge, and these issues informed the scenario development process.[61]

Box 8: How ESPA tested the role of ecosystem models in African policy-making

The WISER (Which Ecosystem Service Models Best Capture the Needs of the Rural Poor?) project evaluated the effectiveness of a range of modelling approaches for mapping several ecosystem services – stored carbon, water availability, charcoal and firewood forest products, and grazing resources – at multiple spatial scales across sub-Saharan Africa. Several points emerged from the WISER study.

- Ecosystem service modelling tools and models are a resource to help decision-makers address a variety of resource management questions, particularly in assessing how different actions will affect ecosystem services and the economic value of these services.
- Models have different levels of accuracy. Generally, more complex models are more accurate. However, in any application, the accuracy of a model cannot be known without validation against measured ecosystem service data.
- Decision-makers should be aware of the uncertainty in model predictions and its impact on their decisions. Uncertainty may be reduced by constantly improving the model's fit to the available data; continuing to gather information during policy implementation to ground-truth, assess and improve the models; and, where possible, by running multiple models for the targeted ecosystem service(s) to generate a range of possible outcomes.

An ESPA survey of 60 technical experts in Africa showed that they unanimously found ecosystem models to be useful in advising policy-makers – when there was enough data and the models were deemed sufficiently accurate. They emphasised the usefulness of modelling alternative scenarios or counterfactuals as a basis for discussion with policy-makers and to highlight the ecological consequences (and their social implications) of different measures.[62]

Joint discovery and knowledge creation

To develop sound understanding of the links between human and ecological systems requires a marriage of scientific knowledge with ground-truthed, more localised knowledge from the people who are affected by environmental decisions.

The use of modelling tools by scientists and technical experts can be part of a well-designed assessment of situation analysis, but alone it is not sufficient. Any assessment of social–ecological drivers, impacts and responses needs to be validated by representatives of the social groups involved and affected.

Some ESPA projects working at local and subnational scales have gone further than consulting – and have partnered directly with community groups to involve them in gathering information about the state of the environment and human–environment interactions, in various 'citizen science' initiatives (see Box 9).

"Ideally, 'consumers' of research become active co-producers of research. This is not only instrumental for impact, but also improves the quality of research. But co-production requires a foundation of trust between researchers and actors at different levels of governance. At the very least, researchers should discuss findings with communities, resource managers, etc. Cheap tools, such as ecosystem monitoring and web-based analysis, stimulate participatory research, build adaptive capacity, and can be extremely useful in remote areas." – ESPA Fellows, quoted in ESPA (2017).[63]

> "Ideally, 'consumers' of research become active co-producers of research. This is not only instrumental for impact, but also improves the quality of research." – ESPA Fellows

Box 9: Citizen science as a way of defining a shared problem

In the Peruvian Andes, the Mountain EVO project pioneered new methods for collecting and analysing data to inform decision-making, involving volunteers from local communities. In the study area, subsistence agriculture and cattle-raising are central to local communities' livelihoods, but heavy grazing of mountain pastures in the uplands, combined with increasing water scarcity and irregular rainfall, has created new uncertainties and vulnerabilities. The Huamantanga community is under severe pressure to implement water and land conservation practices, not only to improve their own livelihoods but also to respond to the heavy demands for water coming from the capital city, Lima, the country's economic backbone and one of the driest cities in the world. The Mountain EVO project trained community volunteers to collect data on the water cycle, including rainfall levels, river flows and air temperature. This was combined with existing data, including satellite imagery and measurements from governmental monitoring networks, and then analysed to generate results relevant to local concerns. The information was fed back to the local community and disseminated via posters and web-based tools to decision-makers at the local and national levels. Locally, the Mountain EVO project's introduction of participatory data collection methods has enabled communities to look at different scenarios and take informed decisions about the ideal balance between cattle grazing and streamflow, ultimately adjusting their catchment management practices to optimise this balance.[64]

PART III: ACTION FOR A MORE SUSTAINABLE FUTURE

Action for a more sustainable future

Deliberate effort and design of governance approaches are needed if environmental resources are to be used to alleviate poverty. The processes of scientific and locally based discovery described above help to make the trade-offs explicit. Building on this knowledge base, processes of negotiation are required to navigate the trade-offs in ways that benefit society's most marginalised people instead of leaving them worse off.

The following sections focus on the tools and elements of governance for negotiating the trade-offs that have been scrutinised and proposed by ESPA researchers, and summarise key policy recommendations.

Recognising and granting rights

Affected local people need statutory rights to access, manage and govern environmental resources – among these, officially recognised tenure rights are among the most important.

'Rights-based' approaches have existed for some decades as an important commitment to ensure that all interventions identify and respect the rights of all affected actors. One of the most important institutions that determine the extent to which individuals and communities can control the benefits they derive from ecosystems is tenure. The 'bundle of rights' concept recognises that traditional tenure systems typically have layered rights to resources, ranging from the right to access a resource to the right to manage it and exclude others.[65] While over 2 billion people live in lands held under customary tenure,[66] only one fifth of these are formally recognised[67] and rural communities are particularly at risk of losing their customary lands.[68] In some countries, requirements that land must be actively used in order to be owned can discourage farmers from practising traditional long-fallow systems which may

otherwise provide many ecosystem services. One ESPA study recommended that changing the formal tenure of indigenous territories to enable local control over land use would help to redress the power imbalance and make relationships more equal.[69]

Inequitable tenure rights among women and men remain one of the most persistent injustices that undermine effective governance of environmental resources in many places – although inequitable rights among all social groups should be scrutinised and addressed. In the case of indigenous people, the process of free, prior and informed consent (FPIC) is supposed to protect their land and resource rights. However, there remains a lack of clarity about ownership by indigenous people of sub-surface minerals and stored forest carbon, for example. The FPIC process is applied variably in different sectors, and is least effective where it is arguably most needed, namely where communities lack full legal rights and capacity.[70]

Box 10: A framework for managing protected areas equitably

Protected areas provide important global, national and local benefits, such as conserving biodiversity, acting as a sink for carbon dioxide and providing clean water flows. By 2020, the Convention on Biological Diversity expects 17% of the world's terrestrial area, and 10% of coastal and marine areas to be conserved in protected areas of some kind.[71]

However, protected areas often impose a cost on local communities. For example, local people may not be able to continue with traditional land-use practices such as shifting cultivation, grazing their livestock, or hunting and gathering food items for their livelihoods.

As protection leads to an increase in wildlife, local people may suffer from increased conflict with wildlife, in the form of (for example) elephants or monkeys destroying their crops and people may even be injured or killed by protected species.

In some cases, people may be evicted from a protected area or prevented from accessing it for culturally important activities. Frequently, local people may not be properly consulted about the boundaries of the protected area and have very little involvement in management decisions.

Where compensation is provided, for example in the form of development projects or tourism income, these benefits may be too little too late and often do not reach those who need them most.

Research funded by the ESPA programme has developed an equity framework that can help to avoid the injustices caused by protected areas, whether these are managed by governments, environmental non-governmental organisations (NGOs) or communities themselves.

The framework has three dimensions: recognition, procedure and distribution. 'Recognition' means respecting the rights and values of local people. This can be particularly important for indigenous people who may lack the ability to make their voices heard.

'Procedural equity' means ensuring that all relevant people can participate effectively in decisions that affect them, that decisions are taken in a transparent manner and that there are mechanisms for resolving disputes.

'Distributive equity' means that negative impacts of protected areas should be mitigated and any benefits shared out fairly. Applying this equity framework is not only justified on moral grounds; it can also improve management effectiveness in protected areas. People are more likely to support management interventions if they consider them to be equitable.

Applying the equity framework can help ensure that protected areas are governed effectively and equitably, delivering benefits to both the local and the global communities.[72]

Accountability to affected people

Policies and programmes should be designed with mechanisms in place to ensure that actors working across scales (local, national and global) of environmental extraction and use are accountable to affected local people.

ESPA's work highlights the pressing need for improved accountability to local people – not only by more equitable participation in decision-making (as above), but also in active promotion of more equitable **outcomes**. ESPA research has highlighted the risks to resource-dependent people when environmental conservation programmes have stronger accountability mechanisms reporting to national or international bodies than to local people. For example, a study of forest management in Kenya found that the 'implementation gap' between Kenya's progressive 2005 Forest Act and participatory forest management on the ground is in part caused by forest officers having greater upward accountability (expressed in their role as forest law enforcers) than downward accountability as community facilitators.[73] Environmental conservation programmes aimed at promoting global benefit – such as carbon sequestration and storage in forests, agriculture and other land uses – demonstrate similarly mixed accountabilities and the need for streamlined mechanisms to track more equitable outcomes (see Box 11).

Box 11: Governing environmental resources fairly across local, national and international scales: A case study from Madagascar

Many of the examples given in this report of identifying the links between human wellbeing and the natural environment, the limits and thresholds between safety and danger zones for particular ecosystems, and the decisions over and management of resources for human wellbeing – involve multiple stakeholders operating at multiple scales of influence. Here we show how this works in practice.

The Corridor Ankeniheny Zahamena (CAZ) protected area in Madagascar illustrates the interlinked nature of community-, national- and international-level governance. The funds available to support communities around the CAZ are dependent on the level of income the national government can obtain through REDD+ (reduced emissions from deforestation and forest degradation and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks) agreements, negotiated with international funding bodies, which in turn is based on calculations of how much CAZ will reduce shifting cultivation by communities and hence carbon emissions.[74] A minimum level of skills, understanding and mutual trust is required among individuals and institutions at all these scales in order to achieve both environmental and poverty alleviation outcomes.

An ESPA research team studied intensively how different members of communities benefitted from REDD+ agreements. They found that wealthier and better-connected members benefitted the most. The researchers from Madagascar and partner institutions in multiple countries worked as knowledge intermediaries to present their findings and encourage responses. They convened discussions from the community level and with the aid of translated materials (including comic book strips and posters), to the highest policy levels of the Government of Madagascar.[75]

Transparency

The intended outcomes and beneficiaries of development and conservation interventions should be communicated transparently to all – and should be monitored and communicated regularly.

It is not enough merely to identify ecological thresholds and the social and ecological costs of different environment–development options. To negotiate the difficult trade-offs over stewardship and use of environmental resources, there must be transparency about the findings. Without transparent information-sharing, affected stakeholders cannot meaningfully participate in decision-making. ESPA initiatives have trialled ways of making the use of environmental resources more transparent, including with the use of information and communications technologies (ICTs) (see Box 12).

Box 12: Mapping the uses of ecosystem services

The ESPA-funded project Sustainable Poverty Alleviation from Coastal Ecosystem Services (SPACES) has studied the relationship between ecosystem services and the wellbeing of poor people living along the coast in Mozambique and Kenya. Ecosystem services are unequally distributed across social groups. The distribution of benefits is determined by gender, ethnicity/migrant status, wealth/assets and other factors. Culture and context influence how benefits are experienced and distributed to different types of people. This distribution can change over time as a result of social, cultural and economic developments, but change can also be directed and accelerated by policy and programme decisions.

The project's interactive, graphically based tool has demonstrated in a visual way how access to environmental resources affects different social groups. This allows the user to explore the proportions of household survey participants who met or did not meet their basic needs by site, gender, age and engagement in fishing.

Decision-makers can use the tool to examine the implications of proposed development interventions by:

- exploring how basic needs are met or not met by different development interventions
- looking at how ecosystem services and goods impact on basic needs
- comparing one site with another
- looking at who has access to an ecosystem service
- seeing the quality of the ecosystem.

A similar data visualisation approach could be adopted elsewhere to support public debate and decision-making processes.[76,77]

Participation

Socially marginalised groups should be empowered and actively supported to participate in environmental decision-making.

ESPA research teams have documented effective participatory approaches to environmental decision-making, which led to actions that achieved positive environmental and positive socioeconomic outcomes for the most vulnerable and socially disadvantaged people.

- One study found that customary and community-based forest management approaches offered the greatest potential to deliver on both ecosystem health and poverty alleviation.[78]
- In coastal Kenya, around the Mombasa Marine National Park, multi-stakeholder workshops functioned effectively as a means of generating information and collaborative understanding necessary to underpin decisions regulating fishing activities. Here, the participatory approach revealed that plans to support at-sea fishing at the expense of land-based fishing would affect groups beyond the fishers themselves, including female fish traders.[79]
- An experimental social learning process in the Lake Baiyangdian catchment, China – a heavily polluted and degraded catchment – involved national government ministry and agency representatives and local officials in an intensive, three-workshop process, supplemented by field visits and consultations with villagers. This process built relationships and raised awareness of social–ecological dependencies among key groups of water managers. It provided the basis for developing a longer-term social learning platform and reframing 'water catchment management' (which implies a static approach) to 'water catchment managing' (a more dynamic and promising approach for restoring the area's degraded resources).[80]

A key point is that participation must be meaningful – as in the above examples. ESPA uncovered many instances of 'lip service' in which consultation with affected people was a box-ticking exercise and did not influence decision-makers' preconceived ideas. This has proved far from easy, as such participation challenges the power of government, the private sector and community members with greater social status and wealth. To make participation more meaningful may require challenging power relations and power dynamics across and within levels of governance.[81]

Capacity development

Programme managers need training in environmental and social literacy and facilitation skills.

ESPA looked at how local communities that are managing environmental resources may need to be educated or trained on larger environmental processes, trends and impacts. However, it is not only local people who may need support in order to participate meaningfully in programme design and implementation.

ESPA's experience shows that it takes skill to run inclusive processes to ensure that marginalised people genuinely have a voice. Whether decentralising resource management to the local level or establishing a reciprocal water agreement, both community members and the staff of facilitating government bodies or NGOs need training to initiate and support sustainable interventions.

Two types of capacity development are needed for programme managers. First, they may benefit from ongoing training on the science of social–ecological systems and its implications for management. An ESPA study found a high degree of willingness among African decision-makers for such engagement. Two thirds of decision-makers surveyed do not use ecosystem service models that could help

them with their jobs, due to a lack or a perceived lack of availability of capacity. Training in model usage could provide them with further, useful information.[82]

Second, facilitators or 'intermediaries' are needed to steer environmental management processes skilfully between the scientific and local realms of knowledge. Sometimes single individuals possess the skill and talent to act as an interpreter or bridge between these two different arenas. At other times, a dedicated intermediary institution needs to play the role. Either way, programme managers commonly need support and training to run effective, participatory and inclusive processes to govern environmental resources.

Recognising and rewarding contributions

Local people's stewardship of environmental resources and their contribution to flows of ecosystem services and goods – in their many forms – must be adequately recognised and sufficiently rewarded.

Where local people are providing environmental stewardship at some cost to themselves, and environmental benefits are enjoyed by groups in another locality, then their contribution should be recognised and it should be rewarded – both for the sake of intrinsic fairness, and to incentivise continued environmental stewardship. ESPA research has documented the successful use of cash transfers or the provision of in-kind materials (such as agricultural inputs) that are provided in exchange for environmental work as part of governmental schemes or for taking environmental measures on a landholder's property. With poverty alleviation as their starting point, such approaches are known broadly as 'conditional transfers'.

In Ghana, the world's second-largest cocoa producing country, cocoa production is in the hands of smallholder farmers who sell on their beans to companies for processing and sale. In central Ghana, the Ecolimits project has worked with farmers to help them understand the overall environmental condition of the cocoa-forest landscapes, so that they can avoid environmentally destructive practices and use a range of conservation techniques, including mulches and retaining shade trees on cocoa farms, to boost their yields. The private companies that procure raw beans recognise that these environmentally sustainable measures are good for their long-term profitability as well as the individual farmers' incomes, and the companies are now providing farmers with support packages in the form of subsidised agricultural inputs – to encourage further use of these measures.[83]

Market-based initiatives – 'payments for ecosystem services' schemes – designed to incentivise environmental stewardship by providing market-based rewards have received particular scrutiny in ESPA research and yield specific policy pointers. Although such initiatives provide financial incentives for sustainable use of environmental resources, they focus primarily on environmental outcomes. Typically, local people's wellbeing is not central in their design. For example, a review of the evidence on four certification schemes, focused on forests, fair trade and carbon, found that without deliberative efforts to support local access and benefit-sharing, these schemes tend to favour large-scale and/or high-capacity producers and reinforce existing market inequalities.[84] Unfair distribution of costs and benefits were also found in a case study of biodiversity offsets in Madagascar, governed by the Business and Biodiversity Offsets Programme and associated international standards.[85] Similar challenges are associated with payments for ecosystem services schemes, particularly when they are reliant on monetisation or marketisation of ecosystem services.

With regards to REDD+ programmes, researchers have highlighted how an excessive focus on 'technical' issues related to carbon measurement and accounting (which lies at the core of performance-based payments for emissions reductions) obscures power imbalances and favours the interests of external actors and investors over local communities. These findings demonstrate that although market-based type instruments may deliver on efficiency, they do not necessarily deliver on equity and poverty alleviation.[86]

ESPA research suggests that both the 'conditional transfer' model and also the market-based 'payments for ecosystem services' model have the same starting point: the assumption that direct, conditional incentives are the most effective way to change behaviour. However, conditional transfers, with their focus on social protection, have had limited environmental impact, and payments for ecosystem services schemes have struggled to engage the most economically marginalised people and to alleviate poverty. There is significant scope for developing hybrid programmes that take advantage of the best of both approaches (see examples in Box 13).

Successful conditional transfer and payments for ecosystem services schemes have common enabling conditions: high-level political support, sustainable financing streams, lean institutional set-ups, tools and systems for effective implementation, and a clear ability to demonstrate impact.[87]

Box 13: Rewards for environmental measures, and how they can benefit the poorest members of society

'Watershared' scheme in Bolivia, with extension to Colombia, Ecuador and Peru. This approach is a type of hybrid scheme based on in-kind transfers such as bee hives and fencing materials, rather than money, to strengthen and formalise pro-conservation social norms. The programme publicly recognises individuals who contribute to the common good by conserving their 'water factories' in upper catchments. It started with the community of Los Negros in Bolivia and spread. Fifty Bolivian municipalities had adopted the model by 2017 – involving 5,635 upstream farmers and 245,000 downstream water users, transferring around US$500,000 per year.[88]

Mikoko Pamoja community carbon project in Kenya. In this scheme, payments from carbon sales go towards supporting conservation and rehabilitation of mangroves, environmental education and community development activities. Carbon credits (offsets) are sold by communities under the Plan Vivo Standard. The project generates about US$38,000 per year. Some of this income is being used to supply water to 75% of community members.[89]

Learning and adapting

As environmental resources continue to be used over time and the physical sustainability of their use and replenishment is monitored – so must social impacts and responses be measured and monitored, and governance goals and management should be adapted.

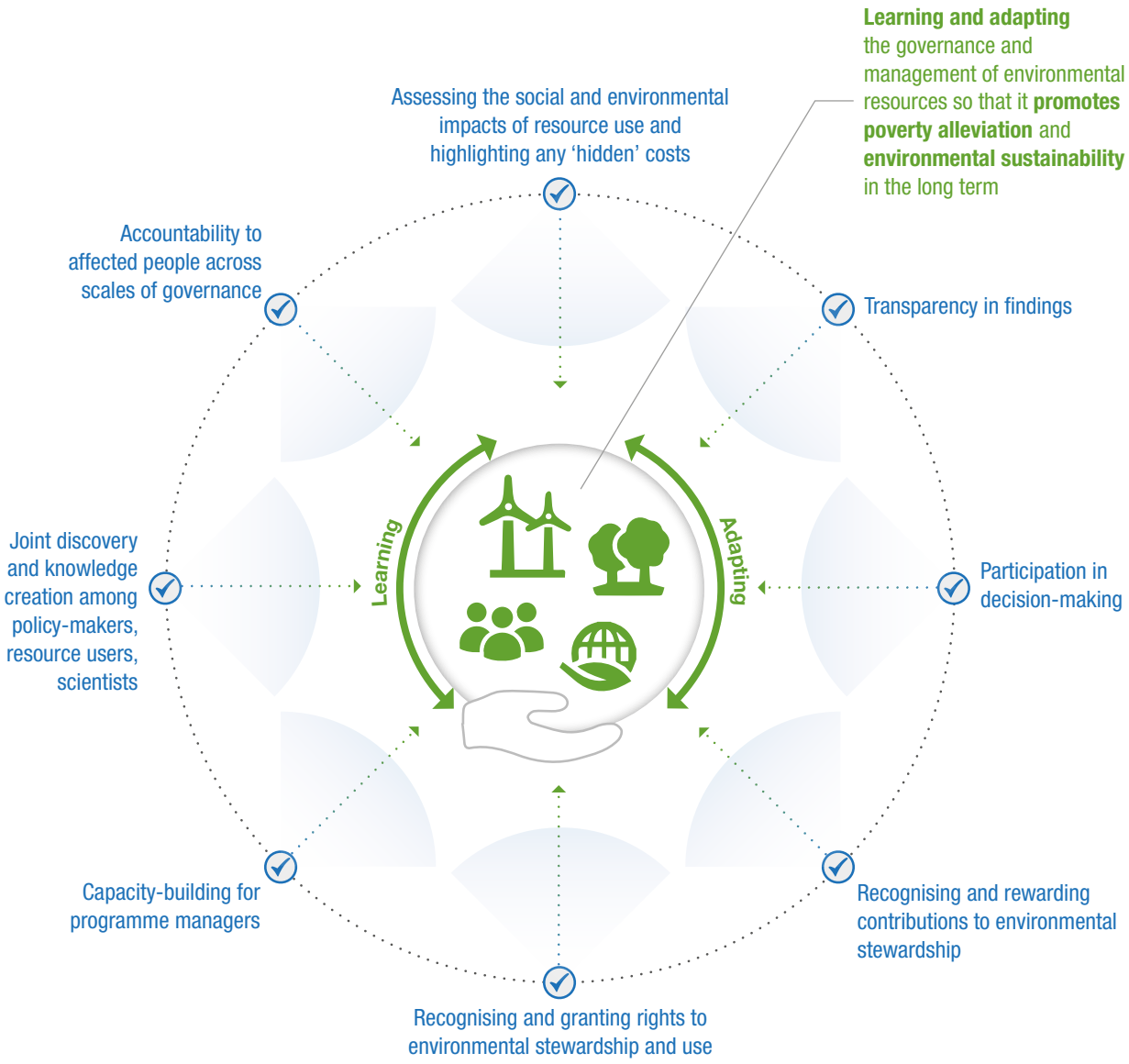
We live in a dynamic world of constant change: of local places that change continuously; and of national, regional and global events and pressures that have local consequences. This means that the institutional and governance arrangements for use of and access to environmental resources must be kept under frequent review, including who benefits, and who may be harmed by the arrangements.

Governance systems must be adaptive and able to cope with often rapid changes in the local context. Sometimes these rapid and unexpected changes are biophysical or ecological changes where a tipping point or threshold in the natural environment is suddenly reached – or alternatively, when a natural disaster occurs (e.g. a storm, flood, drought, heat wave or earthquake). Sometimes political and economic decisions by influential actors have deep impacts on the distribution and use of environmental resources, calling for further responses by others.

For instance, ESPA researchers have written about how – in river catchments – the dynamics of land and forest management and their knock-on effects on hydrological processes, and the complex interactions within communities and between upstream and downstream actors, call for adaptive water management strategies that respond to "changing knowledge and political developments".[90] In one example, the town of Palampur in the Himalayan foothills was negotiating a reciprocal water access agreement with upstream communities – when proposed expansion of electric pylons through the forested upper catchment by a power company disrupted the social and political status quo and put the reciprocal water arrangement on hold – calling for new strategies.[91]

It is impossible to predict the vagaries of politics and the potential of political developments to change patterns of environmental resource use and impacts on the poorest people. It can be difficult to secure and sustain political commitment to sustainable, fair approaches to resource management. However, the good governance strategies discussed in this summary – ranging from transparency, participation, recognition of rights, and reward for environmental contributions, to accountability to local people across scales of governance – help to create momentum towards fairer and more ecologically sustainable forms of environmental resource use and management. They create systems that are more resilient and resistant to political change. Why is that? Applying these good governance principles can nurture civil servants, programme managers, technical specialists, non-governmental allies and affected people (environmental resource users) who share a common **environmental literacy** and a common **social sensitivity**. ESPA's research findings provide new emphasis on a long-recognised issue: by showing that learning and adaptive processes are **necessary** but **not sufficient** for environmental and social sustainability. They must be underpinned by good governance, as described in this summary and shown in Figure 3, to increase the likelihood of sustainable outcomes in the long term.

FIGURE 3: Good governance and an adaptive, learning approach for fair, just and more sustainable outcomes



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