THE ECONOMICS OF LAND DEGRADATION

Economics of
Land Degradation Initiative:

A global strategy for sustainable land management

SCIENTIFIC INTERIM REPORT

The rewards of investing in sustainable land management

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Special Note:

This version is a revision from the original, dated June 2015.

KEY TERMS

Land:	The Earth's surface and natural resources found there.
Land degradation:	Defined by the United Nations as a reduction or loss of the biologic or economic productivity and complexity of rain-fed cropland, irrigated cropland or range, pasture, forest, and woodland. In this report, it corresponds to the reduction in the economic value of ecosystem services and goods derived from land as a result of anthropogenic activities or natural biophysical evolution.
Ecosystem services:	Benefits humans obtain from ecosystems[1], and usually interpreted as the contribution of nature to a variety of "goods and services". This term encompasses the following three categories normally used in economics[2]: (i) goods (e.g., products obtained from ecosystems, such as resource harvests, water, genetic material, etc.), (ii) services (e.g., recreational/tourism benefits or certain ecological regulatory and habitat functions, such as water purification, climate regulation, erosion control, habitat provision, etc.), and (iii) cultural benefits (e.g., spiritual and religious beliefs, heritage values, etc.). Within the Millennium Ecosystem Assessment[1], ecosystem services are classified as provisioning, regulating, cultural, and supporting.
Sustainable land management:	The adoption of land use systems that enhance the ecological support functions of land with appropriate management practices, and thus enable land users to derive economic and social benefits from the land while maintaining those of future generations. This is usually done by integrating socio-economic principles with environmental concerns so as to: maintain or enhance production, reduce the level of production risk, protect the natural resource potential, prevent soil and water degradation, be economically viable, and be socially acceptable.
Natural capital:	Inputs used for economic production that are derived from natural resources. This form of capital is complementary to other forms such as monetary and physical or human-made capital (e.g., buildings, machinery).
Total Economic Value (TEV):	The full economic value allocated by society as a whole. This includes use value (direct and indirect, option value) and non-use value.
Costs of action:	Costs of appropriate actions to prevent and/or reverse land degradation. It includes the costs of implementing interventions such as conservation tillage, or soil and water conservation structures. They are often better known than the benefits from action.
Costs of inaction:	The forgone benefits under "business-as-usual", when no change is taken towards adopting more sustainable management. It is usually associated with estimates of loss in production and productivity, and represents the maximum benefits potentially derived by taking action, which may or may not materialise fully after action is taken. Economic valuation techniques can be used to estimate them before action is taken. The costs of inaction are often not as accurate as the costs of action, and tend to be greater than the actual benefits derived by taking action.
Benefits from action:	The actual benefits that are derived from taking action. They can be measured accurately after action is taken if they are exchanged on a market. If not, benefits from action can be estimated using economic valuation. They may correspond fully or partially to the potential benefits from action, are estimated before an action has been taken, and are often lower than the costs of inaction.
Cost-benefit analysis:	A comparison of all of the costs and benefits associated with taking action, compared to "business-as-usual" (changing nothing).

Executive summary

In the face of global land degradation and its impacts on humanity and the environment, the Economics of Land Degradation (ELD) Initiative is dedicated to raising global awareness of the full economic potential of land and land services, including market and non-market values (e.g., carbon sequestration, recreational values, nutrient cycling, etc.) and the costs of land degradation. The ELD Initiative is focused on creating efficient and practical tools and methodologies to fully assess lands value and thus encourage sustainable land management.

Valuing land and related ecosystem services is an urgent and necessary action in order to focus attention on land degradation as a serious global problem. Land's economic value is chronically undervalued and commonly determined by immediate agricultural or forestry market values. This focus on short-term gain motivates the highest extraction rates possible from land, leading to unsustainable land management and degradation (the reduction or loss in biological or economic productivity). Between 10–20% of drylands and 24% of globally usable land on Earth is degraded at an estimated economic loss of USD 42 billion per year. This particularly affects the rural poor – those who depend directly upon the land for sustenance and income, and number over 1.2 billion.

There are clear economic and environmental actions that can prevent and/or reverse land degradation. Further, the adoption of sustainable land management could deliver up to USD 1.4 trillion in increased crop production. Given the combined global trends of increasing population and decreasing land availability and quality, there is great incentive to increase productivity on parcels of land already in use and promote sustainable land management.

The costs of taking action to prevent and/or reverse land degradation are usually less than the benefits that can be obtained for investing in and applying sustainable land management practices. The case studies reveal that even with an incomplete assessment of the total value of ecosystem services, investments in land prove to be beneficial to society and the environment.

Several existing options and pathways for action to address land degradation are available for successful change. These options range from adapting to biophysical conditions, to changing livelihood strategies. Examples include: reforestation, afforestation, the adoption of more sustainable agricultural practices, and the establishment of alternative livelihoods such as eco-tourism. Economic instruments to reverse land degradation trends include: payments for ecosystem services, subsidies, taxes, voluntary payments for environmental conservation, and access to micro-finance and credit. In addition, facilitating change requires adaptations to legal, social, and policy-focused contexts that favour sustainable land management.

The ELD Initiative will inform the private sector of the opportunities available for investment and will help close the gap between better land stewardship and business practices. The companies likely to be the most interested in efforts to prevent and/or reverse land degradation will be those that have more direct relationships with land and thus be the most sensitive to land degradation. They will be found in resource-dependent sectors, such as the food and beverage, leisure and travel, and basic resource sectors.

The ELD Initiative will provide total economic valuation methods that will aid decision-making in land investments and land use planning, especially under the various conditions of any country affected by land degradation. Three main outcomes of the ELD Initiative will include: (i) a vigorous case study analysis of existing literature and research to analyse the global research status of ELD, separated into three working groups of: *Data and Methodology, Scenarios,* and *Options and Pathways to Action,* (ii) the funding of further research that addresses identified gaps in knowledge, technology, policy, and community motivation, and (iii) the development of a series of reports summarizing final conclusions and guidelines, individually targeting policy makers, scientific communities, the private sector, and local administrators and practitioners. Outputs of the initiative will inform the United Nations Convention to Combat Desertification (UNCCD) and its proposal for a new Sustainable Development Goal for post-Rio+20 of **zero net**

land degradation (defined as the achievement of a state of land degradation neutrality).

African, Asian, and Central and South American countries need to build their capacity in assessing the value of land. Current case studies indicate that much of the work done on economic valuation in these areas has been done by the international scientific community without adequate involvement or capacity building within the studied countries. The ELD Initiative will incorporate capacity building activities into its projects to ensure that qualified personnel are available and present in affected countries.

The ELD Initiative is uniquely posited to address economic issues surrounding degraded lands, as a collaborative, international collection of researchers and citizens committed to delivering comprehensible, transboundary, scientific, political, and technological guidelines rooted in peer-reviewed research and designed for on-the-ground, customisable applications. This interim report is a reflection of work that has been performed, synthesised, and analysed, hitherto, building on earlier studies and ELD contributions to the conclusions and recommendations of the UNCCD Second Scientific Conference.

Acronyms and abbreviations

BMZ	Germany's Federal Ministry for Economic Cooperation and Development (Bundesministerium für wirtschaftliche Zusammenarbeit und Entwicklung)
ELD	Economics of Land Degradation
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH
IFPRI	International Food Policy Research Institute
PES	Payment for Ecosystem Service
REDD	United Nations Reducing Emissions from Deforestation and Forest Degradation
REDD+	United Nations Reducing Emissions from Deforestation and Forest Degradation (plus conservation)
SLM	Sustainable Land Management
TEEB	The Economics of Ecosystem Services and Biodiversity
TEV	Total Economic Value
UNCCD	United Nations Convention to Combat Desertification
UNEP	United Nations Environment Programme
UNU-INWEH	United Nations University – Institute for Water, Environment and Health
WTP	Willingness to pay
ZEF	Center for Development Research, University of Bonn, Germany

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Introduction

The ELD Initiative is a global endeavour focused on land degradation and sustainable land management in an economic context. The ELD Initiative aims to provide a methodology for total economic valuation that is both locally applicable and globally relevant, and based on peer-reviewed research and viable economic strategies. Land degradation is a serious global concern, particularly in light of increasing populations and a slowing down of crop yield increases. Rectifying this issue will necessitate a trans-disciplinary, multi-faceted approach that integrates sound economic valuations, and can be applied practically to inform decision-makers.

The first chapter of this report analyses the current state of affairs; a review of degradation and decreasing crop yields demonstrate this issue is on the rise, and is a serious global concern when compounded with increasing population. The complexity of land-use decision-making is comprehensively explored. The second chapter looks at the ELD methodology, including a justification and breakdown of the Total Economic Value approach, and how it can be applied. The final chapter is a preliminary synthesis and analysis of the 186 case studies compiled thus far. It points to a preponderance of research performed in developing nations by researchers from developed nations that is focused on agricultural valuations, with studies increasing over the past 5 years. These conclusions demonstrate a lack of capacity within developing nations despite increasing interest as a result of the recent food price spikes, and a focus on market valuations. The ELD seeks to rectify these issues with a practical, supportive approach to full economic valuation.

01 Why are the economics of land degradation and sustainable land management important?

> **The nation that destroys its soil destroys itself.**
>
> *Franklin D. Roosevelt [1937]*

Land and the benefits that can be derived from it have been taken for granted and undervalued by civilisations both past and present, despite warnings of the need for careful land stewardship found throughout ancient writings[3,4]. Today, the pressure on land has reached such a critical point that serious doubts have been raised on the capacity of land to meet the demands of a human population rapidly increasing to 9 billion[5]. Demands for land include traditional demands for food and water flow regulation, and newer demands for biofuel production, climate regulation (including carbon sequestration and storage), spiritual, aesthetic, and recreational activities. Furthermore, during the last 20–30 years, land has been degrading globally[6]. This is mainly the result of land mismanagement, drought related-famines, and misperceptions of plentiful food production, large food stocks in Europe, open land frontiers, relatively cheap subsidised food, low land prices, and abundant energy and water resources.

Land degradation threatens fertile land throughout the world. The consequences are alarming: food insecurity, pests, reduced availability of clean water, increased vulnerability of affected areas and their populations to climate change, biodiversity loss, presence of invasive species, and much more. It is estimated that 1 to 1.5 billion people in all parts of the world are already directly negatively affected by land degradation[7].

Adopting sustainable land management: Securing environmental services, increasing food security, and alleviating poverty

The realisation that land has actually been neglected is belatedly beginning to gain traction, especially following the recent food crises. Between 10–20% of drylands and 24% of globally usable land on Earth is degraded at an estimated economic loss of USD 42 billion per year[87]. This includes a startling loss of grain worth USD 1.2 billion yearly. By 2050, at least a 70–100% increase in food production from existing land resources may be needed in order to be able to feed current and future generations[9,10]. If agricultural land productivity remains at its current levels, an estimated 6 million hectares (ha) of land (roughly equivalent to the size of Norway) would need to be converted to agricultural production every year until at least 2030 to satisfy this growing demand. Thus, awareness of the seriousness and extent of land degradation is gradually reversing the traditional disregard for its impacts on both economic and social development in affected countries. The combination of land prices that have been increasing since 2007/2008 and the proliferating rush of foreign investors seeking to buy or lease land is a signal that the world is waking up to threats from land degradation and closing frontiers[11]. Despite this interest, levels of investment in land remain far below those needed to meet the rising demands for food and land-related services. Agricultural investments to the order of USD 30 billion per year are needed to feed our growing global population[10,12].

Answering the economic questions of land degradation and providing integrated frameworks for informed action are particularly important in the context of increasing land scarcity. Globally, the human population has reached a stage where cultivated areas can no longer be expanded except in limited areas of South America and Sub-Saharan Africa, and even then the geographical extent of exploitable land may be over-estimated[13].

Furthermore, land degradation most directly impacts one of the most vulnerable human populations – the rural poor. More than 1.2 billion people live on fragile lands in developing nations, where they are clustered in fragile environments, remote areas, and/or on marginal lands, and depend directly upon the most degraded land for their sustenance and income[14,15]. Poverty and land degrada-

CASE STUDY 1

Total economic valuation and the establishment of national and international markets for ecosystem services

(Turner et al. 2012 [17], as reported in The Guardian's Global Development [18])

If the world's poor were paid for the services that they indirectly provide to the rest of the planet by preserving some of the world's key biodiversity hotspots, they could reap up to USD 500 billion, as shown by a study entitled Global Biodiversity Conservation and the Alleviation of Poverty[17]. 17 of the world's most important areas for biodiversity were accordingly analysed in this study led by a team from Conservation International, and co-authored by scientists at NatureServe, the United States National Fish and Wildlife Foundation, and the University of Wisconsin-Madison.

The researchers found that the monetary benefits derived from safeguarding these habitats (such as providing valuable services from food, medicines, clean water, or absorbing carbon dioxide from the air) are more than triple the costs of conserving them. Some of the ecosystem service benefits were directly used by the local people themselves (e.g., using forests as sources of food, medicine, and shelter) while the rest of the benefits exist on regional or global scales.

Many conservation and ecosystem service benefits are invisible; e.g., maintaining the vegetative cover of wooded lands can help prevent mudslides during heavy rainfall and also provides valuable watersheds that keep rivers healthy, provide clean drinking water, and absorb carbon dioxide from the air. These benefits are economic losses that are only obvious once it is too late.

There were some fledgling schemes reviewed that could help raise funding for sustainable land management – e.g., the United Nations-backed system called REDD (Reducing Emissions from Deforestation and forest Degradation), which uses carbon trading to generate cash and preserve trees – but they are all currently rather small in scale.

In regards to the value of nature and the impacts of environmental valuation for the rural poor, Will Turner, vice-president of Conservation International and lead author of the study, said: "Developed and developing economies cannot continue to ask the world's poor to shoulder the burden of protecting these globally important ecosystem services for the rest of the world's benefit, without compensation in return. This is exactly what we mean when we talk about valuing natural capital. Nature may not send us a bill, but its essential services and flows, both direct and indirect, have concrete economic value."

In this study, the "action" is the provision of compensation to local providers of environmental services (the poor), who directly depend on and benefit from good management of natural capital, while also delivering benefits at a regional and global scale. Total Economic Value can help assess the needs and opportunities for such compensation mechanisms, as well as the tools to scale them up and out. This is also one way to help the poor leave the poverty-environment trap they may be stuck in.

tion have a mixed relationship, as examined in Barbier [14] and described by von Braun and Gerber [16] and Barbier[15], and can either increase the impact of or be one of the drivers of land degradation.

Under certain conditions, the rural poor can find themselves perpetuating patterns of land degradation, because they have no alternative ways to ensure their survival in such hostile environments. These "asset-less" poor are most likely to suffer from extreme land degradation, resulting in a "poverty-environment trap" [14]. Better land management must provide immediate beneficial impacts to household livelihoods in order to alleviate poverty, especially for the rural poor. Provided that they are rewarded for their maintenance of/contribution to the services that land can provide which are beneficial at the global level (such as carbon storage) or regional level (such as water purification) (see *Case Study 1*), fostering the adoption of sustainable land management by the poor could enable the greatest and most efficient rewards in achieving food security and global land restoration.

However, if the poverty-environment trap does not close up on them, the poor naturally act as caretakers of the land they depend upon, as they are the first to most directly benefit from good land management. Through this, they effectively limit land degradation. In this case, scaling up practices adopted by the poor and establishing an enabling environment could bring great and efficient results in achieving food security and global land restoration.

As part of discussions focused on the post Rio+20 sustainable development goals, the United Nations Convention to Combat Desertification (UNCCD) has proposed a target of **zero net land degradation**. In order to attract the necessary investments to prevent and/or reverse land degradation, this goal will require a focus on the economic value of land and the economics of land degradation. The provision of monetary figures reflecting these assessments and potential returns on investment are extremely valuable tools when presenting sustainable land management options to investors. For example, closing yield-potential gaps and reaching 95% of potential maximum crop yields (assuming the adoption of sustainable land management) could create an additional 2.3 billion tonnes of crop production per year[19], equivalent to a potential gain of USD 1.4 trillion. Furthermore, when the numerous values of alternative and complementary land uses are added in, it is quite clear that there are huge investment opportunities for those committed to achieving improved land management that will not result in environmental degradation.

Speaking the language of public and private decision-makers

The scientific rationale for adopting sustainable land management is now well established in the academic literature[20] and often recognised by practitioners. In spite of this, there is a noticeable lack of adoption of such practices. There is a range of reasons for this gap, including a lack of financial resources required to switch to sustainable land management[21], as well as technical, political, legal, cultural, social, environmental, and economic contexts that render these practices unsustainable in the long run. Technological interventions to prevent or reverse land degradation are available and well documented[20,22,23,24], but are rarely analysed in terms of cost and benefits. They also lack identification of the contextual conditions required for success. As a result, there is a need to identify where the adoption of sustainable land management is economically justified, and to remove any barriers to implementation.

Governments and policy/decision-makers are faced with a multitude of demands on limited resources, and require common metrics to compare options. These metrics usually work on monetary terms, so it is important that land is given its full value, measured from the point of view of society *as a whole*. When valued in this manner, appropriate policies and finances can be directed towards land stewardship, sustainable land management, and risk management.

What needs to be considered in order to achieve sustainable land management?

The known discrepancies in land management practices between knowledge and action further exposes a need for concise data and harmonised methods. These methods will provide answers to questions about the social and economic costs of land degradation, and the benefits of greater investments in land based productivity. These answers will then foster long-term win-win scenarios over just short-term gains.

An initial assessment of the economics of land degradation showed that in many cases the cost of action against land degradation is lower than the cost of prevailing actions[25]. More scientific knowledge is necessary, especially regarding the valuation of non-use ecosystem services and off-site effects of sustainable land management. To that end, several case studies have been or are being piloted in different world regions in order to assess the costs and benefits of sustainable land management as well as to contribute to further methodological developments[26]. The technical, political, legal, cultural, social, and environmental contexts should also be analysed and suitably adapted to enable successful economic situations for improved land management. This will enable governments, decision-makers, and the public and private sectors to make informed, defendable choices based on a sound economic approach beyond market values, thus establishing a favourable environment to promote the adoption of sustainable land management.

Market prices for land are generally based on the *direct productive potential* (i.e., the market value/actual retail price of timber, crops, etc.), but it is recognised that these prices often do not accurately reflect the full value of land. This is especially the case when land values do not comprehensively include the four types of ecosystems services that land provides (*Box 1*). These services include not only products used for food, fibres, and shelter, but also the regulation of water quality and quantity, and biodiversity maintenance. When these additional values are factored in, the worth of land easily increases several-fold[27]. The need to fully value land has become more urgent in response to the aforementioned increases in foreign land investments. Sometimes called "land grabbing" by its opponents, as much as 80 million ha globally may already be leased or otherwise negotiated with foreign investors[28]. Access to water resources is also often key in these land deals, but rarely accounted for explicitly despite its importance[29]. Under these types of conditions, better economic land valuations can provide a basis for fairer financial compensation for countries and their citizens, particularly if the latter are displaced from or dispossessed of land that they have traditionally used (see *Case Study 3* and *Case Study 4* for illustrations).

BOX 1

Ecosystem services
(adapted from the Millennium Ecosystem Assessment[1])

Provisioning goods provided such as food, water, fibre, timber, fuel, minerals, building materials and shelter, and biodiversity and genetic resources

Supporting primary production, soil formation, and nutrient cycling

Regulating benefits from regulation of processes such as climatic events, water flows, pollution, soil erosion, and nutrient cycling

Cultural non-material benefits such as spiritual or aesthetic, and education, as well as more material benefits linked to recreation (tourism) and hunting

TABLE 1

Hypothetical evaluation of three options for soil and water conservation practices that address land degradation on hillsides
(adapted from Biot et al. 1995[30])

	Options for action		
Criterion for decision-making	**Bench terrace**	**Grass strips or trash lines**	**Intercropping**
Technical performance	+ + +	+ +	+
Fits with existing practices	–	+	+ +
Cost related to importance of problem	–	+	+ +
Cost related to famers' capabilities	–	–	+
Short-term benefits	–	–	+
Fits with farmers' understanding	–	+	+ + +
Fits with existing land tenure system	+	+ +	+ + +
Fits with local institutional framework	+	+	+ +

Determining current and future land use practices and rationale: An example of behaviour patterns beyond farmers' land-use decision-making

Studies on why available sustainable land management technologies are not being adopted have given way to questions about how land users actually make land management decisions. This area of research evolved as a result of the failure of past efforts to promote technological interventions and strategies that consider the decision-making process. Part of the issue is that perceptions of degradation vary with and between different land users, scientists, and research/extension agencies. The complexity of decision-making for land use is illustrated in *Table 1*.

Table 1 shows a hypothetical example of three possible actions that could limit land degradation on hillsides. As shown by weighting the variables, bench terraces may seem like the most effective technique technically, but are in reality are often beyond farmer's capabilities as they may not have the financial or labour assets to construct them. Bench terracing also requires additional labour beyond that which is normally available at a household level, thus requiring either substantial social capital for collaborative work or access to monetary capital to hire the necessary labour. This need for additional labour and associated costs may outweigh financial benefits derived from the increased technical performance, and could act as an economic barrier to adoption.

Often land users either do not have a clear idea of the economic costs/benefits within their decision-making time frame, or the total costs and benefits may be over- or under-estimated. In a context like that shown in *Table 1*, an alternative option like inter-cropping may be preferred, as it meets more of the decision-making criteria and is therefore perceived by the decision-makers (farmers) as more desirable and feasible. As analyses of potential options demonstrate, failure to understand the economic, political, legal, cultural, social, and environmental factors as well as their interactions, can result in continued land degradation even when technology is available to prevent it. *Table 1* is a simplified example of just one gap that can be bridged by focusing on a more detailed assessment of the costs and benefits, and taking into account the decision-making process and potential barriers to adoption.

Choosing a way forward: Agricultural and alternative livelihoods

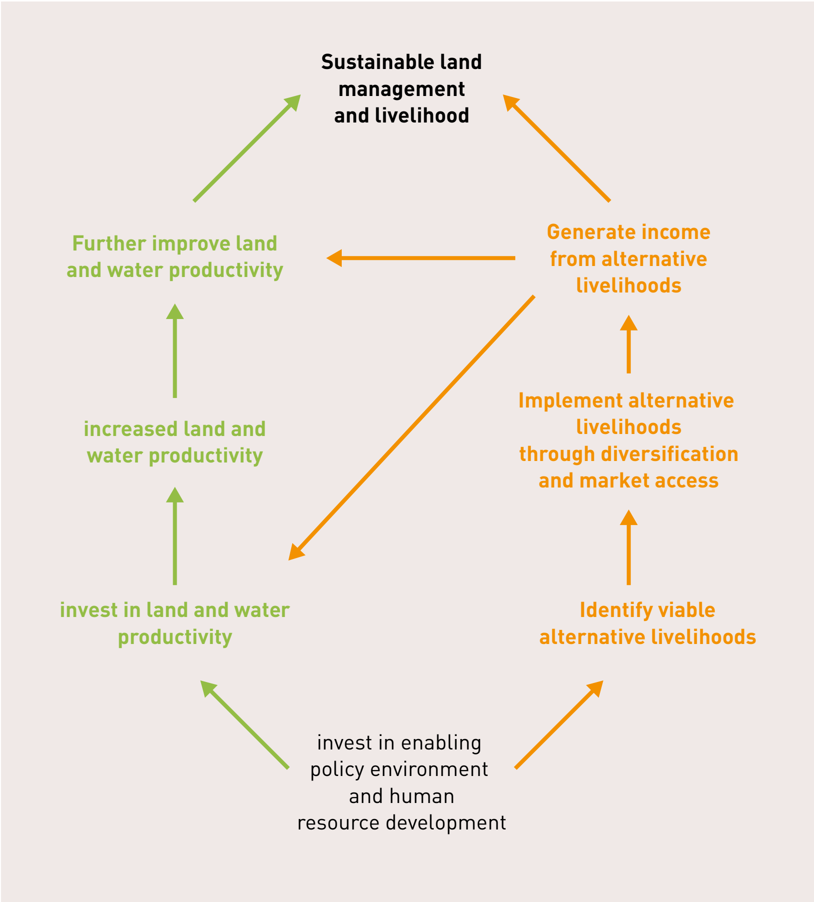
The achievement of sustainable land management requires not only economic considerations based on primary production from land but an in-depth understanding of how people obtain their livelihoods and how they can build up their assets in order to invest in sustainable land management. This is especially important in areas with high incidences of degradation, such as drylands.

For many and perhaps the majority of people living on degraded land, over 50% of their income is not directly derived from the productivity of the land through agriculture or forestry, but rather through alternative livelihood strategies that have minimal dependence (or pressure) on land resources[31,32,33]. Examples of alternative livelihoods include: aquaculture, apiculture, artisanal craft production, eco-tourism, renewable energy generation (solar and wind), high value horticultural production (under plastic-covered housing), and adding value to existing plant and animal products through processing[34]. Integrating these current alternative livelihoods into sustainable land management plans is thus integral to a comprehensive strategy.

Pathways to sustainable land management and human well-being are depicted in *Figure 1*. The left side of *Figure 1* (green) represents a traditional agricultural/pastoral livelihood where investments are facilitated by enabling policies, regulations, access to agricultural markets and research/extension services, and include inputs such as agrochemicals, water, and seeds. This pathway is often complemented by alternative livelihood options that are independent from agricultural production (e.g., eco-tourism), and is depicted on the right side of *Figure 1* (orange). These alternative livelihoods

FIGURE 1

Pathways to sustainable land management, considering agricultural (green) and alternative livelihoods (orange)
(adapted from Adeel & Safriel 2008[35], sourced from Thomas 2008[34] pg. 599)



could reduce pressures exerted on currently exploited land, thereby promoting more sustainable land management and alleviating poverty. Both pathways require private investments that are supported by public sector investments and training in skills, knowledge, and capacities to manage livelihood strategies.

The choice of a livelihood pathway can be informed by economic cost-benefit analyses. These analyses can make use of valuation techniques to estimate the benefits derived directly or indirectly from land management, including situations when benefits are not formally traded through monetary exchanges. This type of analysis can help guide investment decisions, (i.e., in determining the flow of financial assets generated through alternative livelihoods into land and water productivity versus other options). Additionally, to achieve public sector investments and public support for private sector investments, there remains a need to integrate: (i) land degradation issues into mainstream government policies, and (ii) economic analysis into policy implementation and design. This integration will require raising awareness of the monetary costs and benefits of sustainable land management. It is important to note that any strategy trying to increase the allocation of funds to sustainable land management must be appropriate to an individual country's environmental, political, economic, and institutional frameworks and conditions[36].

In the decision-making process for the management of land and land based services, numerous elements must be considered. These elements exist on scales ranging between the household, community, regional, national, and international, and include:

- The perception of the symptoms of degradation and impacts on crop yields and water quality to determine how easily (costly) land degradation could be addressed

- A diagnosis of degradation causes and drivers to determine the kind of action required for the reduction of land degradation
- A prioritisation of needs and corresponding actions
- The identification of solutions (i.e., alternative agricultural and non-agricultural livelihood options for action)
- An assessment of the technical feasibility of the solutions
- An economic analysis of costs, benefits, and risks
- An assessment of access to monetary capital
- An analysis of policy incentives and disincentives, price distortions, and political context
- An assessment of the legal context (i.e., formal (land tenure) or informal property rights)
- An assessment of the need for collaboration and extent of access to social capital (social network)
- An analysis of the cultural context, including gender aspects (who owns land, makes decisions, and conducts work)
- An analysis of expected environmental impacts and potential environmental trade-offs

Given the heterogeneity in the assets and capabilities of land users, there is an urgent need to go beyond classical or linear programming models that only focus on increasing agricultural productivity[37]. Also, in addition to considering the full value of land-based ecosystem services, there is a need to examine and adapt the decision-making process for effective action against land degradation and the loss of livelihoods it induces. The ELD Initiative aims to facilitate this process with globally available, adaptable, and functional guidelines.

Goals of the ELD Initiative

Based on this understanding of the economic issues of land degradation, the aim of the ELD Initiative is to transform the global understanding of land value, and create awareness of the economic arguments for considering both market and non-market values in sustainable land management. This will be achieved by undertaking cost-benefit analyses of land degradation/sustainable land management while systematizing scientific studies on the economics of land degradation, in an effort to move towards a harmonisation of approaches and methods. Additionally, the initiative will provide countries with a robust, cost-effective toolbox of methods that are usable under the varying conditions of all countries affected by land degradation.

The ELD Initiative will produce another three separate reports in addition to this interim report: one aimed at the scientific community, one aimed at political decision-makers and one aimed at private decision-makers. These reports will rely on the discussions and work of the three inter-related working groups of the initiative: (i) *Data and Methodology*, (ii) *Scenarios* (economic valuation of options), and (iii) *Options and Pathways for action*. Existing and new case studies will provide a scientific basis in establishing the cost-effective toolbox of methods. Further details of the working groups and the initiative can be found at www.eld-initiative.org.

Chapter 2 provides an outline of the approach to estimate the economic benefits and costs of action and assess whether action is economically justified.

CHAPTER

02

The ELD methodology in assessing potential economic improvements; using and expanding upon existing approaches and frameworks

The ELD Initiative draws from existing frameworks and approaches of environmental economics, adapting and expanding them to include features specific to land management. The questions these frameworks and approaches attempt to address include:

- From an economic perspective, how can we decide whether it is worth taking action to foster sustainable land management or not?
- Why and how should the economic value of land and land-services be estimated, especially when they do not have a market price?
- What kind of problems exist in relation to land management, what kind of economic analysis can be used to decide how to address them, and what possible actions can be taken once informed by an economic analysis?
- How is complexity reduced to estimate the economic value of land and land-services more easily using the ecosystem services framework?
- In addition to the ecosystem services framework, how is complexity reduced using the Total Economic Value framework? What steps can be taken to pragmatically identify a relevant valuation method based on available data and resources, local capacity, and objective of the study?
- Is there a difference between the costs of inaction or the benefits from action, and which of those should we compare against the costs of action? What kind of economic solutions can be adopted for given problems?
- How is the best economic option chosen for action? What criteria can be used to identify which option should be chosen?
- What other economic approaches could be used for decision-making as alternatives to cost-benefit analysis?
- What are the necessary conditions for economically desirable actions to be successful?
- How can we answer all the previous questions by adopting a sequential approach? Can we identify simple steps to implement informed action?
- How can we identify representative case studies to scale results up and obtain a global estimate of land degradation?
- How do we know which case studies to select to inform the analysis of a given problem, and if there are none, how do we choose case studies to be commissioned?

This chapter briefly details the frameworks and approaches that have been established to answer these questions, and discusses how they are connected. It builds on the previous work commissioned by Germany's Federal Ministry for Economic Cooperation and Development to the Center for Development Research (ZEF) and the International Food Policy Research Institute (IFPRI)[38], and considers the conclusions of the second scientific conference of the UNCCD[39]. These frameworks and approaches are all rooted into an economic perspective and allow stakeholders to consider alternative options for action. These options for action are based on alternative livelihood options, which include agriculture as well as other economic sectors of land-based activities (e.g., eco- or wildlife-based tourism, arts/crafts, medicines, mining, etc.). Other perspectives (technical, political, legal, cultural, social, and environmental) can be taken to inform action. Because of the nature of the ELD Initiative, this report focuses on an economic perspective, with conditions for success identified from complementary perspectives.

How do we know sustainable land management is economically worth adopting?

Land is a viable asset in and of itself, and the ELD Initiative focuses on the costs and benefits derived from sustainable land use and land-based economic activities. The overarching goal is to provide an economic rationale for promoting good land stewardship and related policies, to complement the existing well-recognised scientific rationale.

Cost-benefit analysis is a tool derived from accounting that compares the costs of undertaking an action or a project (in this case, of adopting sustainable land management practices) against the benefits derived from it. The costs of adoption of sustainable land management practices ("action") are fairly well known [22], but the full economic benefits of action are often missing or only partially known. This information gap exists either because changes to the land have not yet occurred and thus cannot be measured in practice, or because only a fraction of the economic benefits are being translated into market prices and the true value of these economic benefits are therefore imperfectly measured by market prices. Economic valuation methods can be used to estimate the true value of economic benefits of action and address some of this information gap.

In this context, a cost-benefit analysis will compare the economic benefits of adopting sustainable land management practices (for agricultural or alternative land-based economic livelihoods) against the associated costs. The costs and the benefits of adopting these practices or land-based livelihoods depend upon the level of action taken and change achieved, which in turn depends on the causes of land degradation and the processes driving it. Once both the costs and benefits derived from action have been estimated, the net economic benefit from action, equal to the economic benefits minus the costs of action, can be estimated.

One of the major advantages of a cost-benefit analysis is that it quantifies everything monetarily, either through market prices or economic values. This homogenous unit of measurement allows for direct comparisons between costs and benefits across different scenarios. Quantifying costs and benefits in monetary units can also help provide an idea of the scale of desired implementation (i. e., from a village market to international trade).

Cost-benefit analysis can help identify the most economically efficient practice for a given scientific, political, legal, cultural, or social context. Long-term change requires that the chosen practice identified as having the greatest net economic benefit is not associated with economic and/or non-economic barriers (technical, political, legal, cultural, social, or environmental) in order to ensure this practice is actually implemented. When such barriers to adoption exist, ensuring the actual adoption and successful implementation of the chosen action framework requires the removal of these other barriers. A cost-benefit analysis can be helpful in identifying how to best enable action through the setting up of economic incentives or policy instruments. This analysis simulates the scale and impact that the introduction of such instruments will have, simulates the removal of existing incentives that have adverse economic and environmental impact on land management, and identifies potential social consequences of change in land-based economic activities. Removing barriers to adoption requires a good understanding of landholders' attitudes, behaviours, and incentives towards the adoption of sustainable land management if sustainable land management is to be effectively promoted and adopted.

Why value nature (and not price it)?

Economists make a clear distinction between market price (also called financial price) and value. The economic value of a good or service reflects the preferences that society as a whole has for (and therefore allocates to) this good or service. A price is determined by the market as the result of interaction between demand and supply. However, markets and market prices do not always exist although the goods or services themselves exist. For example, simply because one cannot buy a litre of clean air on the market does not mean that clean air does not have a value to society. Additionally, markets that do exist may be imperfect and have prices that do not reflect economic values perfectly. When this is the case, economists refer to market failures. These failures lead to a sub-optimal use of scarce resources. Action can be taken to correct such failures, for instance, through the setting up of economic instruments, and a cost-benefit analysis, which is used to inform the setting up of such instruments.

> Nowadays people know the price of everything and the value of nothing.
>
> *Oscar Wilde, The Picture of Dorian Gray [1890]*

By adopting the perspective of society as a whole, sound economic analysis can help decision-makers:

TABLE 2

Problems related to land management, economic analyses, and possible actions

Type of problem	**Decide between options (e.g., development vs. conservation)**	**Redistribute from winners to losers**	**Set up new markets**
Examples	**Case Study 2**	**Case Study 3 and Case Study 4**	**Case Study 5**
What is economic valuation used for?	Make an informed choice/decision-making between options	Assess the level of compensation to be implemented *within* the economy	Assess the potential for livelihood diversification as a form of risk management and resilience building
Tools	Perform a cost-benefit analysis, with estimated, non-marketed (unpriced), but existing economic benefits	Perform a cost-benefit analysis, explicitly identifying the economic link between winners and losers	Create and establish the new market
Action (assuming a favourable technical, political, legal, cultural, social, and environmental context)	Choose the option with the greatest value to society as a whole	Set up an economic instrument (standard, subsidy, tax, tradable permit): determine the scale of the economic instrument, who it will pay for it and who will receive it (i.e., the redistribution from winners to losers), and who and how the instrument will be administered	Transform values into prices for *existing* non marketed or *new* economic activities (e.g., payments for ecosystem services such as REDD for carbon storage, eco-tourism for biodiversity, eco-certified products, etc.)

- Assess the true costs and benefits of projects, investments, and policies by quantifying the economic impact of changes in provision of environmental goods and services
- Provide a rationale to choose between alternative options for economic improvements
- Support environmental policy by providing information on how to correct market failures
- Raise awareness of potential investment opportunities and their returns on investment to the private sector
- Reduce social tensions (e.g., development vs. conservation) by informing the setting up of an equitable redistribution process from those who economically profit from action ("winners") to those who lose out ("losers"), and informing the establishment of new markets
- Identify conditions for success and non-economic barriers, in order to correct for policy and institutional failures

Table 2 provides examples of common problems relative to land management faced by decision-makers, how economics can assist in the decision-making process, and what possible actions can be informed by adopting an economic perspective. This assumes that there are no technical, political, legal, cultural, social, and environmental barriers to the adoption of economic action.

CASE STUDY 2

Deciding between alternative land options when trade-offs must be made: Vietnam

(Do 2007 [40]*)*

The problem and trade-offs involved:

This case study was carried out on Tram Chim National Park in Vietnam. The park is enclosed by a dyke that was built in 1985. It was intended to retain water during the dry season in an effort to restore wetlands damaged during the Vietnam War. In 1996, local authorities raised the height of the dyke to prevent any fires, which has had two consequences: first, that the water level in the park is now consistently higher than the ecologically optimal level, leading to degradation in the wetland ecosystem, and second, that the higher dykes now protect many farms from flooding, allowing farmers to grow more rice and thus earn a higher income.

This study investigated the impact of proposals by the Park Management Board to reduce the height of dykes in Vietnam's Mekong River Delta. Changes in the park dyke will change water levels for farms in adjacent areas, and hence have impacts on farmers. It is estimated that a reduction in water level in the park by one meter can lead to an increase of 0.2 – 0.3 m of water for adjacent farms. This will have considerable impacts on farmers' farm dykes, cropping, and livelihood due to prolonged flood durations. The changes in wetland management will involve improved vegetation control, increased hydrological and biological monitoring, and stronger enforcement against illegal encroachments.

Method for valuation of economic impact:

In this study, the cost of the dyke conversion is the local farmers' reduced income from rice production, and was estimated using the production function approach and market values. The benefits derived from the improvements in environmental quality (wetland biodiversity) that the proposals should produce were estimated using an environmental choice modelling technique (non-market values).

Two scenarios were considered: one with a reduction in the height of park dykes and one with a reduction in the height of farm dykes. The park dykes surrounding the wetland protected areas were built by local authorities to maintain a high water level in the dry season for fire fighting and prevention. Farm dykes surrounding villages and paddy fields were constructed by local farmers with support from local governments to protect agricultural land, villages, and other infrastructure from annual flooding.

Results:

The study finds that far from being a 'trade-off' between conservation and rural development, proposed changes could produce both an improvement in the Delta's ecology and a net benefit to society.

Scenario 1 (park dykes): It was found that the conversion of park dykes in Tram Chim would reduce rice yields by 0.03 tonnes/ha/year or 1,500 tonnes per year for local farmers in an adjacent area of 50,000 ha around the park. This income loss of about USD 91,875 per year, together with compensation paid by the government for "farmer changing livelihood" costs (costs of adapting to new conditions/jobs after the dyke conversion) and engineering costs, brings the total costs of the proposed five-year programme to USD 3.4 million. On the other hand, respondents were willing to pay for the increased biodiversity values of Tram Chim that would result from the changes proposed in the dyke and wetland management. The aggregated non-market values ranged from USD 3.94 – 5 million, suggesting that park dyke conversion can generate a net social benefit.

Scenario 2 (farm dykes): It was found that the conversion to lower farm dykes would reduce rice yields by 0.24 tonnes/ha/yr, or VND 0.98 million per household per year. It would also reduce the income from livestock rearing. The estimated cost of the dyke conversion would be VND 15.4 million per household per year, and VND 614 billion or USD 38.4 million for the whole MRD. On the other hand, the biodiversity values of all wetlands in the MRD were estimated between USD 41.7 – 53 million. Therefore, the net social benefits would range from USD 3.3 – 14.6 million.

Possible options for action:

The proposed plans represent a win-win for both nature and people. Since society as a whole benefits, there is a rationale for making money available to individual farmers to compensate them for any income losses. The maximum level of compensation to be provided should be equal to the net social benefits.

CASE STUDY 3

A "south-south" (developing country – developing country) demonstration of concern over land deals: Ethiopia

(sourced from The Guardian 2012 [41])

This example is centred on Ethiopia's leasing of 600,000 ha (1.5 million acres) of prime farmland to Indian companies. Further deals involving approximately 200 million ha of land are believed to have been negotiated in the past few years, mostly to the advantage of speculators and often to the detriment of local communities. This has led to environmental destruction, and the imprisonment, intimidation, repression, detentions, rapes, and beatings of journalists and political objectors, according to a new report by the United States-based Oakland Institute.

Nyikaw Ochalla, director of the London-based Anywaa Survival Organisation, said, "People are being turned into day labourers doing backbreaking work while living in extreme poverty. The government's plans ... depend on tactics of displacement, increased food insecurity, destitution and destruction of the environment." Ochalla, who stated that he was in daily direct contact with communities affected by "land grabbing" across Ethiopia, said the relocations would only add to hunger and conflict, "Communities that have survived by fishing and moving to higher ground to grow maize are being relocated and say they are now becoming dependent on government for food aid. They are saying they will never leave and that the government will have to kill them. I call on the Indian authorities and the public to stop this pillage."

Karuturi Global, the Indian farm conglomerate and one of the world's largest rose growers, has leased 350,000 ha in the Gambella province for under USD 1.10/ha/year, to grow palm oil, cereals, maize, and biofuel crops. They declined to comment on these claims, and a spokesman for the company stated, "This has nothing to do with us."

In response to the controversy, the Ethiopian government defended its policies publicly. "Ethiopia needs to develop to fight poverty, increase food supplies, and improve livelihoods, and do so in a sustainable way," said a spokeswoman for the government in London. She pointed out that 45% of Ethiopia's 1.14 million km^2 of land is arable, but only 15% is in use. In contrast, Asish Kohtari, author of a new book on the growing reach of Indian business, noted that the phenomenon of Indian companies "grabbing" land in Africa is an extension of what has happened in the last 30 years in India itself. "In recent years the country has seen a massive transfer of land and natural resources from the rural poor to the wealthy. Around 60 million people have been displaced in India by large scale industrial developments. Around 40% of the people affected have been indigenous peoples", he said. The land developments have included dams, mines, tourist developments, ports, steel plants, and massive irrigation schemes. Thus far, this complexity is not yet resolved in either nation.

In this case, the winners are both the Ethiopian government and Indian investor, and the losers are the Ethiopian farmers. The problem is a lack of a redistribution mechanism through which farmers can also benefit from the deal. One potential action that could provide a win-win situation would be for either the government or investor to provide compensation to farmers. A total economic valuation of land could help this strategy by:

- *determining how much compensation is needed for farmers to be at least as well off after the deal as before, and*
- *determining what fraction of the investor's profits should go back to the government and/or farmers, thereby reducing social unrest.*

This assumes that farmers are those holding the property rights over the land they use and that these property rights can be financially recognised. Land property rights can help determine whether compensation to farmers should be paid by government or the investors: whether the government or investor provide the financial compensation to farmers depends on the modalities defined in the land deal agreement, and more specifically how responsibilities have been legally allocated between the two parties in the agreement.

CASE STUDY 4

Conflict arising from undervaluing land: Sierra Leone
(sourced from The Guardian 2012 [42])

In Sierra Leone, farmers receive USD 5/ha/year for leasing land to a foreign plantation investor under a 50 year contract. However, this payment has been perceived as "unacceptable" to many, as it does not fully compensate farmers for the loss of valuable trees and plants destroyed in the clearing of the land, or more specifically, for the loss of services previously provided by these trees and plants. This perceived unfairness led to social unrest and widespread demonstrations in 2012, turning what could have been a win-win situation into a lose-lose one. Such contestation from the local populace can deter foreign investors and limit further opportunities for development.

In this case, the winner from the deal is the foreign investor, and the losers are the Sierra Leone farmers. The problem is that the redistribution mechanism is so small that farmers feel that they have lost out from the deal. Consequently, both the farmers and the foreign investor lose out from the deal: farmers because of the decrease in their livelihoods and livelihood options, and the investor because of the costs and negative image associated with social unrest. One action could be to revise the level of compensation provided by the investor to the farmers, A total economic valuation of their land and services derived from it could help assess a "fair" level of compensation for the farmers (which should be higher than their current USD 5/ha/year), and thereby reduce social unrest.

CASE STUDY 5

Pioneering a system of payments for ecosystem services for carbon storage and watershed services: Costa Rica [43, 44, 45]

The problem:

In the late 1900s in Costa Rica, forest on privately owned land was rapidly being converted to agricultural land and pastures. This conversion was done without consideration of the value derived from these forests by others, both in Costa Rica and abroad. In response, Costa Rica adopted a law in 1996 that formally recognised the value of environmental services provided by these forests in terms of carbon fixation, hydrological services, biodiversity protection, and the provision of scenic beauty. The country has aimed to provide payments to forest owners for each of these values, but has so far only been successful for carbon fixation, hydrological services, and some biodiversity protection.

What is the level of payment?

Levels of payments have generally been set based on previous payment level provided to forest owners in a different form, and/or after consultation of stakeholders and negotiation. Environmental valuation studies were not used to determine the level of payments, even when available (e.g., the willingness to pay for water quality in Honduras). Payment levels typically tend to be fixed and at a lower level than the costs of provision (opportunity costs). Forest owners around Heredia (Central Valley of Costa Rica) are paid USD 51/ha/year for forest conservation, USD 124/ha for reforestation their first year, USD 100/ha for their second year of restoration, and USD 67/ha for the third to fifth years.

Who pays?

In the case of carbon and other greenhouse gases fixation, polluters (mostly fossil fuel users) foot for the bill – the "polluter-pays" principle. This is in accordance with the Kyoto Protocol on emission reductions which has now become mandatory. On the contrary, beneficiaries can choose to pay for hydrological services on a voluntary basis – the "beneficiary-pays" principle. The Global Environment Facility, which represents global users, granted a budget to fund agro-forestry contracts for biodiversity conservation and carbon sequestration benefits, but the local tourism industry has not yet committed any funds to conserve the benefits of natural ecosystems. Users may or may not be aware of the available payment for ecosystem services in place.

How is the budget levied?

Most of the budget is levied through a mandatory, dedicated tax on fuel sales, with one third of the tax (5% of fuel sales in 1999) earmarked to forestry. A much smaller part of the budget comes from negotiated voluntary payments by water users such as bottlers, municipal water supply systems, irrigation water users, and hotels. This voluntary contribution changed in 2005 to a mandatory conservation fee earmarked for watershed protection as part of a water tariff.

Who benefits?

Costa Rican forest owners benefit directly from the scheme because they receive a financial compensation for forest maintenance. Evidence however suggests that the level of compensation is too low compared to the opportunity costs of conservation. Polluters benefit because they can keep operating on the global market while looking for less polluting technologies or inputs. Users benefit because of the improved environmental quality. They also have a way of expressing their voice through providing for these payments, which was not previously an option.

Ultimately, Costa Rica directly benefits as a country: new institutions have been set up to administer these payments with either with the government or NGOs acting as intermediaries, with the associated creation of employment opportunities and economic activities. Costa Rica has also received payments from other countries for this system of payments for ecosystem services (e.g., from the Norwegian government, private companies, Global Environmental Facility).

Who administers the programme?

The Costa Rican government and its administrations facilitate the budget collection and implementation of payments. Local-level intermediaries have been created in order to reduce the trans-

action costs associated with payment implementation, and take advantage of economies of scale. These local level intermediaries have helped forest owners fill in the paperwork and liaised between forest owners and the government (e.g., FUNDECOR, a Costa Rican non-governmental organisation).

What are the conditions for success?

The ecosystem service values to society are recognised by the Costa Rican legal system. The government has been proactive in establishing such payments on a decentralised basis, letting intermediaries establish themselves, obtaining commitments from both stakeholders and providers, and ensuring environmental objectives are met. These commitments are crucial to ensure long term sustainability of the payments for ecosystem services system.

Being pioneers in payments for ecosystem services meant that Costa Rican stakeholders and institutions have had to be flexible enough over time to evolve and take lessons learnt and changing circumstances into account.

The ecosystem services framework: Ecosystem services classified, valued independently, then aggregated

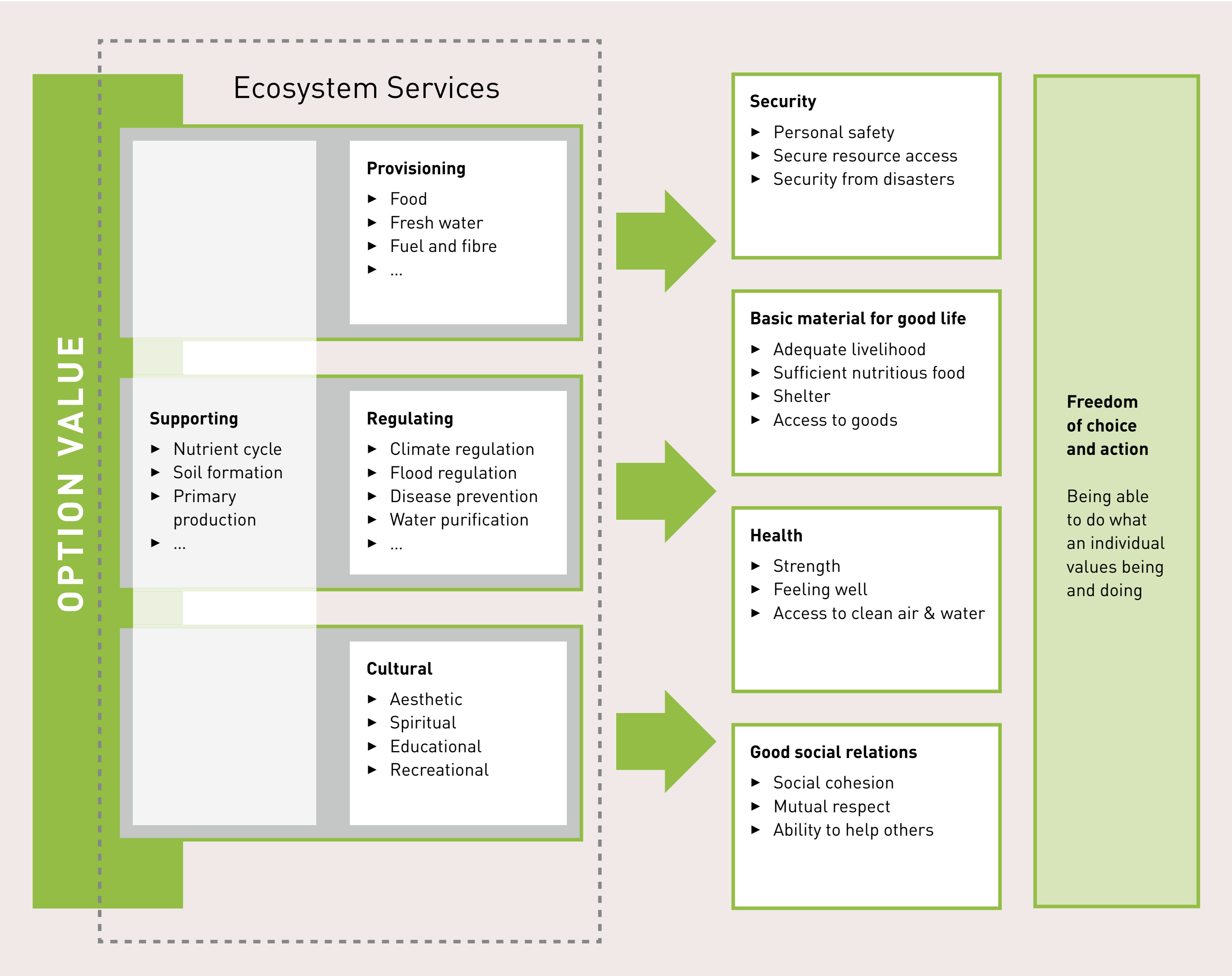
Estimating the true economic value of land is not easy or straightforward, as land provides society with so many different services. The method suggested here is to deconstruct these services into independent categories that can be valued separately without duplicating the value of a single service across categories. The total economic value of the land is then the sum of the values of the identified individual services.

Decision-makers can use the ecosystem service framework developed in the Millennium Ecosystem Assessment[1] to identify a complete list of services provided by land that have an economic value to society as a whole. There are four general types of services: *provisioning* (food, water, fibre, timber, fuel, minerals, building materials and shelter, and biodiversity and genetic resources), *regulating* (benefits from regulation of processes such as climatic events, water flows, pollution, soil erosion, and nutrient cycling), *cultural* (mostly experienced through tourism or religious practices) and *supporting* (primary production, soil

FIGURE 2

The provision of ecosystem services from natural capital: Linkages between ecosystem services and human well-being

(adapted from Millennium Ecosystem Assessment 2005, Figure A, pg. vi[1])



BOX 2

Examples of improved land management derived from economic valuations of ecosystem services

Provisioning services

- The estimation of the costs of soil erosion and the assessment of whether investment in soil erosion is economically viable, using productivity loss, replacement costs, and participatory contingent valuation methods.

Regulating services

- The estimation of non-agricultural and non-timber values can be used to inform the amounts of carbon payments.
- The estimation of pollution costs can be used to inform the establishment of payments for pollution clean up.

Cultural services

- The estimation of recreational values can be used to estimate the potential benefits from establishing or developing the tourism industry.
- The estimation of aesthetic and spiritual values can be used to inform the protection of high value cultural and spiritual assets.

formation, and nutrient cycling). These ecosystem services collectively provide the basis of human well-being and economic welfare. In such a context, and seen from an economic perspective, land degradation is the loss or reduction in services provided by land to society as a whole. This definition also includes the reduction of land on which these services are based, even if the services themselves are maintained through time (e.g., a forest with a river running through can be reduced in size as a result of external development pressure, even though the river itself is still providing its services). The reduction in this natural capital threatens the long-run sustainability of current pathways of exploitation (this is referred to by economists as the *strong sustainability concept*).

Figure 2 shows the relationship between ecosystem services and well-being, and the flow from ecosystem services to human sustenance and well-being, and ultimately to freedom in choice and action. There exist several variations of *Figure 2*, with more or less details[25, 46, 47], but the main concepts and structure behind all of them is essentially the same.

Box 2 details some examples of what valuations of these ecosystem services could be used for, in terms of both the type and scale of economic incentives that can be set up.

The Total Economic Value framework and valuation methods

Increasing competition for land demonstrates that an assessment of the total economic value of land is urgently required, so that land is not undervalued nor overexploited. This will allow concerned parties to make the most of all of their potential economic opportunities. However, the following challenges of this type of assessment must be considered: (i) total economic valuation is currently perceived as too complicated, too costly to estimate, and/or its results are not considered appropriately in the decision-making process, (ii) there is no unique method to measure total economic values, (iii) there is not yet a complete set of methods that are simple to implement and lead to robust estimates of the total economic value of land, and (iv) there are no studies to date that estimate the full economic value of a piece of land based on the range of provided services. Valuations have thus always been only partially complete, making comparisons between sites difficult, if not impossible, as different aspects of land and ecosystem services can be measured in very different ways.

Nonetheless, valuation methods can capture various components of the total economic value for a given service. The fundamental idea is to deconstruct the total economic value into components that can then be summed up together again, while avoiding overlap between these components and preventing duplicate counts. This framework has already been used in ZEF and IFPRI's initially commissioned work on the Economics of Land Degradation[25] and their current ELD project[26], as well as in complementary initiatives like the Economics of Ecosystem and Biodiversity[48] and the UK National Ecosystem Assessment[27]. What remains a necessity is a systematic, empirical estimation of total economic value in relation to land management, in order to get a sounder economic assessment of current land management practices and alternative options.

The total economic value can be deconstructed into *use value* and *non-use value* (*Figure 3*). Use value is the economic value associated with using the land for economically profitable activities. It can be broken down further into *direct use value* and *indirect use value*. Direct use values encompass mostly provisioning services such as food or timber, and indirect use values are those entities not consumed directly but which indirectly support directly consumed goods (e.g., the values of regulating services – nutrient cycling, water flow regulation, soil erosion prevention, etc.). Non-use value is the economic value of land that is not associated with consumption. This non-use value can be broken down further into *existence value, bequest value*, and *stewardship value*. Existence value is the economic value allocated to land or what it supports, simply because it exists. Bequest value is the value of land that is passed on to future generations. Stewardship value is the value of land that is kept in good conditions for both direct economic production and the maintenance of surrounding ecosystems. Option value is based on how much individuals or societies are willing to pay for the option of keeping the asset for future direct and indirect uses, including: drought, flood, and protection from other natural disasters. This is essentially the economic value allocated to strategies that have been adopted to manage potential threats to profits or livelihoods. It is mostly con-

FIGURE 3

Total economic value with types of ecosystem services and examples
(adapted from Nkonya et al. 2011, pg. 70, and Soussan and Noel 2010 [38, 49]*)*

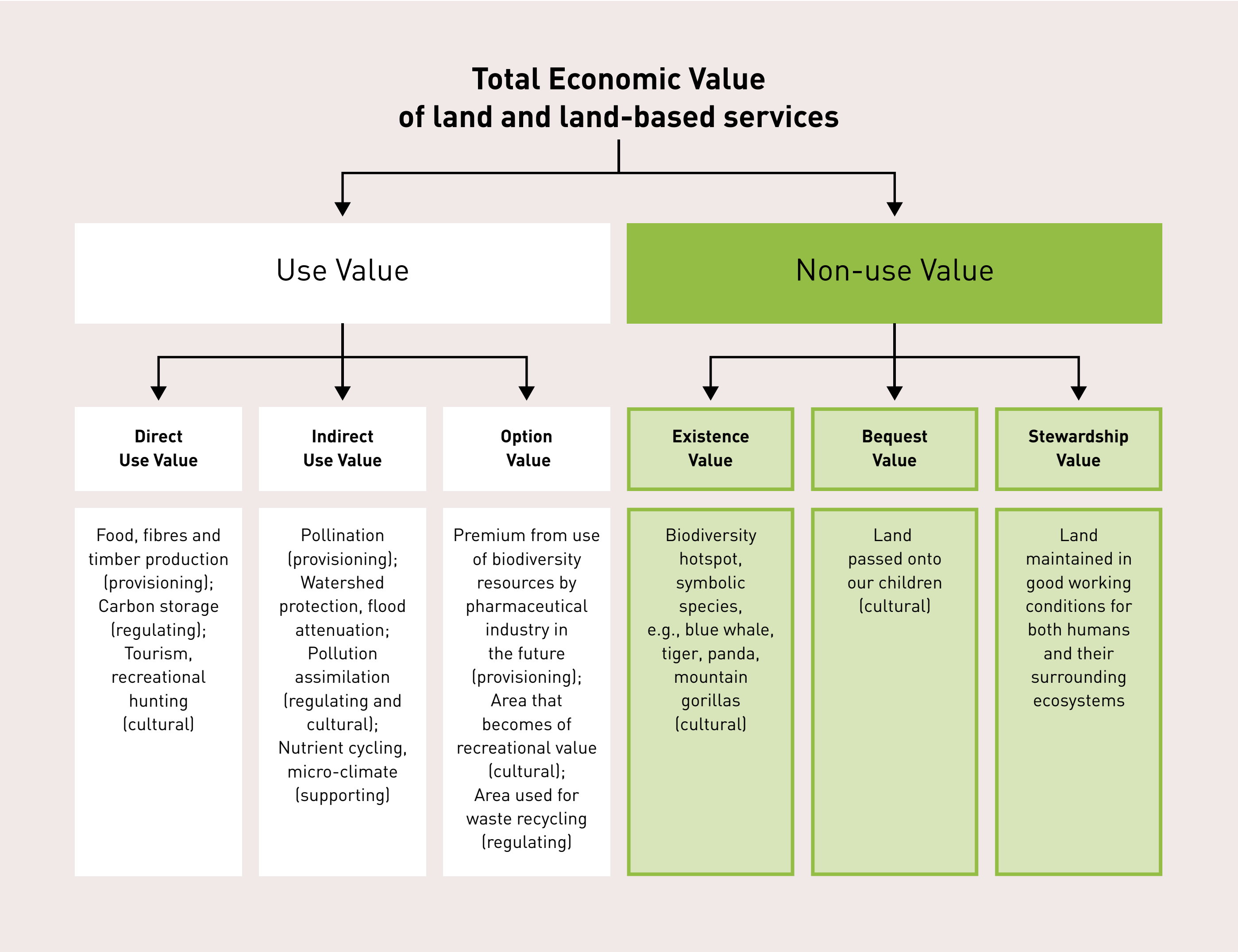


TABLE 3

Examples of calculation of the total economic value for alternative land-based activities

		Land-based economic activities						
		agriculture (non-pastoral)	**pasture**	**mining**	**carbon storage**	**tourism**	**religious practices**	**agriculture (non-pastoral) and tourism**
Use value	**Direct use**	value of agricultural production	value of meat production	profit from mining	payments received from REDD+ mechanism	value of tourist fees, e.g., for entry into a national park	not usually measured in economic terms	value of agricultural production and tourist fees, e.g., for entry into a national park
	Indirect use	carbon sequestration payments, income from on-farm guest houses	carbon sequestration, recreation	not usually measured in economic terms	not usually measured in economic terms	value of hotel and restaurant industry around the national park	not usually measured in economic terms	value of carbon sequestration payments and value of hotel and restaurant industry around the national park
	Option	value of keeping forest stands for future timber sales	pasture set aside to be used only in extreme circumstances such as a drought	future profit by leaving some mining resources into the ground	value of agricultural production under an alternative land use	value of potential profit to be made from tourism if land were developed for this purpose	not usually measured in economic terms	value of keeping forest stands for future timber sales and value of potential profit to be made from tourism if land were developed for this purpose
Non-use value	**Existence**	not usually measured in economic terms	not usually measured in economic terms	mining reserves	not usually measured in economic terms	value of emblematic species, e.g., tigers, blue whale, pandas, mountain gorillas	not usually measured in economic terms	value of emblematic species, e.g., tigers, blue whale, pandas, mountain gorillas
	Bequest	value of inherited land or its production value	value of inherited land or productive value of the herd size that the inherited land can carry	value of inherited mines	value of future payments inherited with the land	value of tourism income inherited from parents	not usually measured in economic terms	value of inherited land, e.g., agricultural and tourism income
	Stewardship	not usually measured in economic terms, but can be embedded into agricultural systems, e.g., Himas in Western Asia or the multi-functionality of agriculture in Europe	not usually measured in economic terms	not usually measured in economic terms	not usually measured in economic terms	not usually measured in economic terms	not usually measured in economic terms	not usually measured in economic terms
Total Economic Value		*sum of all the above*	*sum of all the above*	*sum of all the above*	*sum of all the above*	*sum of all the above*	*sum of all the above*	*sum of all the above*

sidered a use value, but can also be considered a non-use value, as it does not correspond to current use, but rather to future consumption.

The framework provided in *Figure 3* is a simple method to ensure that no part of the economic value is left out when estimating the total economic value, thereby ensuring an accurate portrayal of the economic information. In turn, this will allow for fully informed decision-making. *Table 3* gives examples of these values for a range of different land-based economic activities.

As shown in *Table 4*, the existing literature on land degradation and sustainable land management quantifies:

- Provisioning services: mostly by direct use and option values
- Regulating services: by direct and indirect use values, and option value
- Cultural services: by direct and indirect use values, option value, and existence value

It is worthwhile to note that not all components of the total economic value have been estimated for all types of ecosystem services. This is because such economic valuations can be costly to undertake, and there is generally an incentive to obtain the most relevant information first. Relevance will depend on the cultural, social, and environmental contexts, as well as the objective(s) of the economic valuation and assessment.

Several methods of valuation can be used to capture the economic value of an environmental good. These are described briefly in Appendix 1 with an assessment of their advantages, limitations, and potential use. These valuation methods have been used for valuation of the environment, mainly since the 1980s. Some are still being refined to improve the accuracy of estimated environmental values, but can provide relatively good estimates of value when the context of the study is taken into account appropriately.

Market price, replacement costs, dose-response methods, damage cost avoided, mitigation costs, and *opportunity costs* can be referred to as *non demand-based methods* as they do not involve the estimation of a demand curve for services.

The *hedonic price method, travel cost method, contingent valuation,* and *choice experiment* all rely on estimating a demand for a good or service, and are therefore all demand-based methods. The hedonic price method and the travel cost method are called *revealed preference methods* as they estimate a use value from surrogate markets; the use value is "revealed" from these other markets. Contingent valuation and choice experiment rely on people

TABLE 4

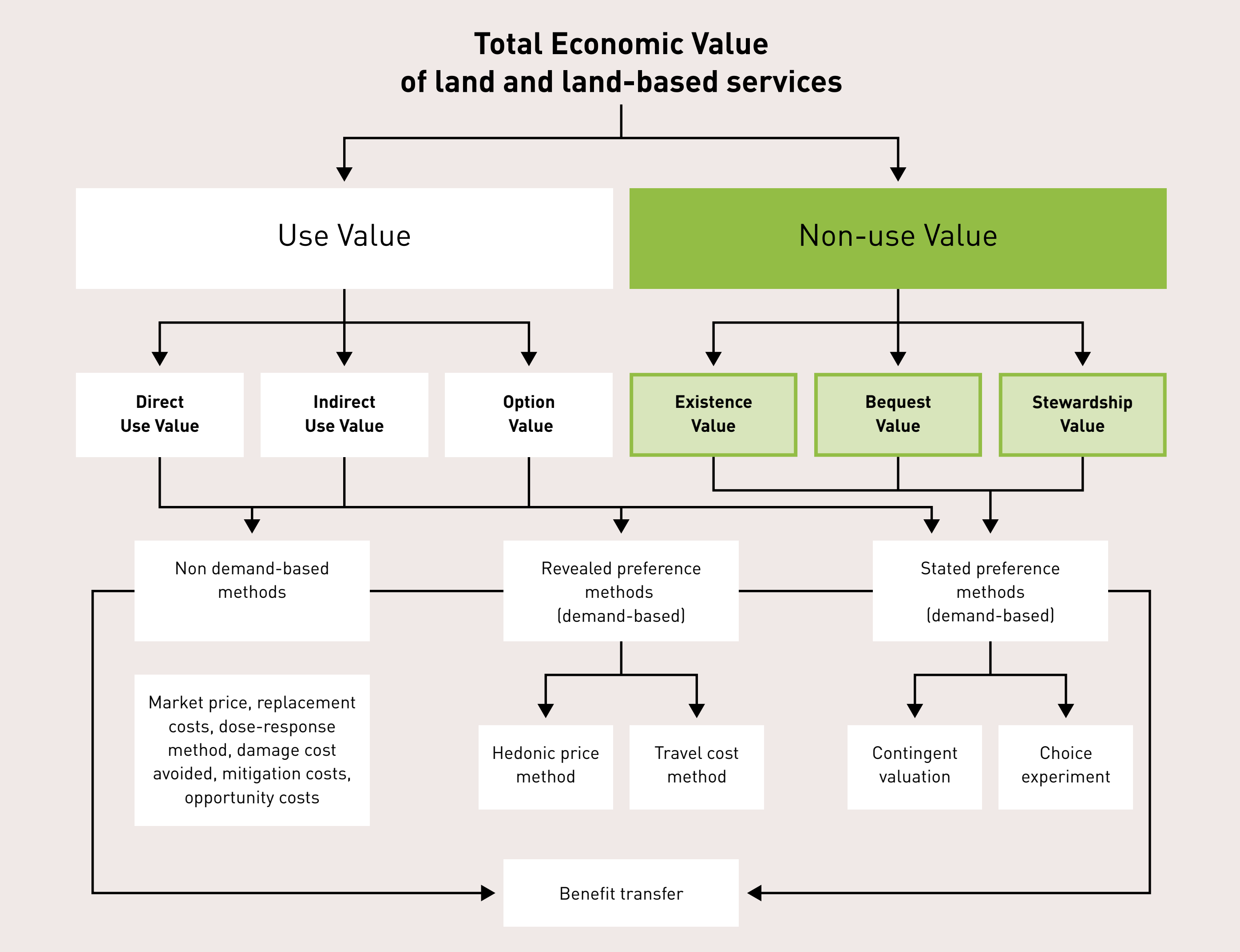
Economic value types that are typically estimated for each ecosystem service
(from Quillérou and Thomas 2012 [50])

		Provisioning services	Regulating services	Cultural services	*Supporting services*
Use value	Direct use	✔	✔	✔	
	Indirect use		✔	✔	✔
	Option	✔	✔	✔	
Non-use value	Existence			✔	
	Bequest				
	Stewardship				

Supporting services are represented in italics as they are not valued on their own, but rather through other ecosystem services. This is to avoid the issue of double-counting.

FIGURE 4

The Total Economic Value concept and existing valuation methods
(adapted from Bertram & Rehdanz 2013, pg. 28 [51])



stating their willingness to pay for a service (linked to the total economic value allocated to this service), and are therefore *stated preference methods*.

Figure 4 builds up from *Figure 3* and shows the different valuation methods (detailed in Appendix 1) that can be used for each sub-component of the total economic value, as there is not just one way to estimate economic values.

In addition to the objective of the study, the choice of method depends on the data, resources, and local capacity available to undertake such economic valuations[52]. Each method has its advantages and limitations, both in terms of method and data, and is used in relation to a specific problem (Generic limitations to the applications of methods in developing countries are highlighted in *Box 7*). The choice of method to be applied can be very pragmatic, and the following steps can be used to determine which method to select and apply from those detailed in Appendix 1 [52]:

(1) deciding the type of environmental problem to be analysed;

(2) reviewing which valuation method is appropriate for the environmental problem to be analysed;

(3) considering what information is required for the identified environmental problem and chosen valuation method;

(4) assessing what information is readily available, how long it would take to access it and at what monetary cost.

Valuing the costs of inaction or the benefits from action: What are the differences and implications?

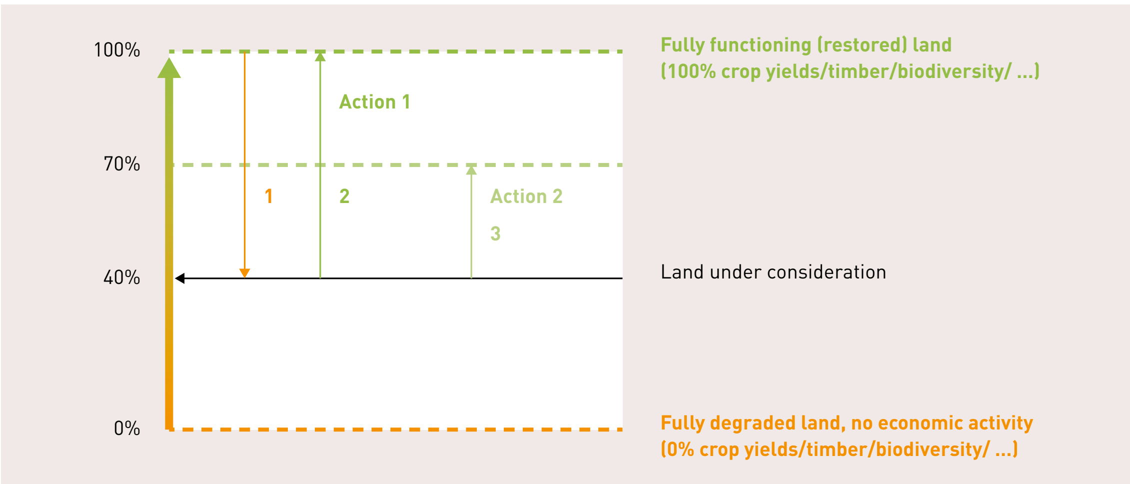
Most people confuse the *costs of inaction* with the *benefits of action*, which sometimes correspond and sometimes do not. For example, *Figure 5* demonstrates a piece of agricultural land operating at only 40% of its productive capacity (e.g., with crop yields reaching 40% of the crop yield potential for the region). Failure to protect the land from degradation is considered inaction and corresponds to the difference between the piece of land producing only 40% of its potential yield, and a piece of land operating at 100% productive capacity (Arrow 1). If the piece of land is effectively restored from 40% to 100% of its productive capacity (Action 1), then the benefits from that action (Arrow 2) are equal to the costs of inaction (Arrow 1). However, if action restores land to only 70% of its productive capacity (Action 2), then the benefit from action is the difference between those derived for land at 70% productive capacity and land at 40% productive capacity (Arrow 3). In this case, the benefits from action (Arrow 3) are less than the costs of inaction (Arrow 1).

The costs of inaction have been considered by previous and on-going studies such as the Stern Review on Climate Change[53], The Economics of Ecosystems and Biodiversity[48], the UK National Ecosystem Assessment[27], and the Economics of Land Degradation research project led by the Center for Development Research (ZEF) and International Food Policy Research Institute (IFPRI)[26]. However, since the costs of inaction are greater or equal to the benefits from action, using the costs of inaction as the primary focus may lead to overestimations of the actual benefits from action (*Case Study 6*). This will in turn lead to disappointment and frustration, especially for private investors, as they will not see the expected benefits materialise. This could limit further action and investment and thereby be counter-productive. Theoretically, this approach also gives a better estimate of actual economic benefits and associated money flows that occur after action, and allows for consideration of partial land restoration.

Based on the merits of discussions that have evolved amongst environmental economists, the ELD Initia-

FIGURE 5

Continuum of land states between fully functioning and fully degraded, and the relationship between the costs of degradation and potential benefits from restoration
(adapted from Quillérou & Thomas 2012[50])



Arrow 1 (orange) corresponds to the costs of land degradation; Arrow 2 (dark green) corresponds to the potential benefits of land restoration; Arrow 3 (light green) corresponds to the effective benefits from land restoration.

tive tends to give more weight to the benefits from action rather than the cost of inaction. This approach is also supported by the Offering Sustainable Land Use Options (OSLO) consortium.

Framework for decision-making: A comparison of the economic benefits of action (or costs of inaction) against the costs of action, and decision-making criteria

Previous studies estimate the costs of land degradation at USD 42 billion per year[87]. This is a high cost to pay for land degradation and begs the question of whether or not the potential benefits of reversing land degradation are worth acting upon. Will the adoption of sustainable land management or alternative land-based economic activities lead to greater benefits than costs? A cost-benefit analysis is a powerful tool that can help answer this question.

In this context, a cost-benefit analysis compares the benefits of adopting sustainable land management or alternative land-based economic activities against the associated costs of taking such action (*Figure 6*). This deviates slightly from the methodology of comparing the costs of action to the costs of

CASE STUDY 6

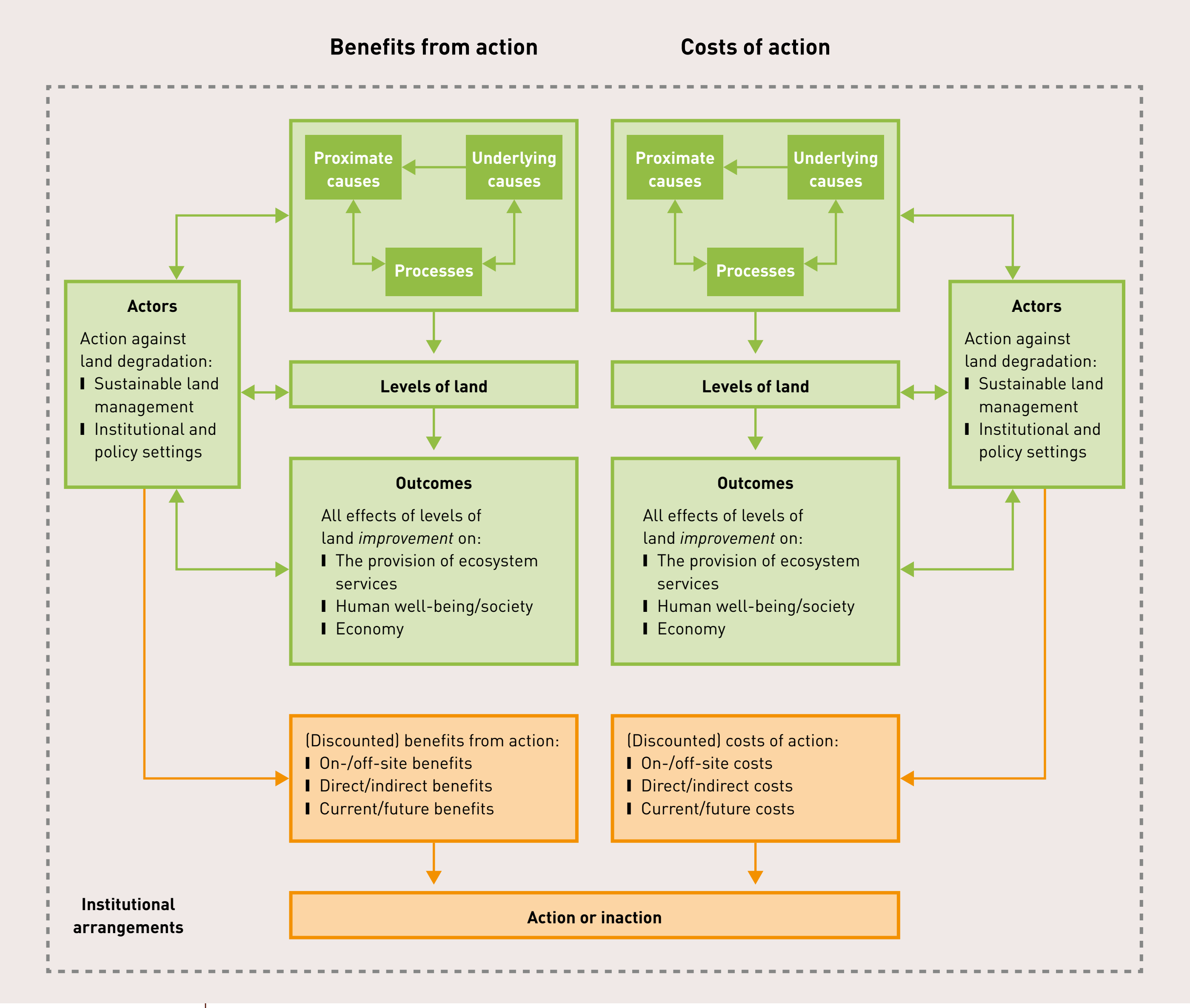
Expected benefits prior to action did not fully translate into economic benefits after action

(sourced from Kosey et al. 2007 [44])

Three technical studies, including an economic valuation, were conducted in Honduras to inform the provision of a payment scheme for water-related environmental services. Regardless of the quality of these studies and the reliability of their results, the fee charged to fund the payment scheme was only 3.6 % of the water users' estimated willingness to pay. This means that not only was the valuation study not used to inform policy, and therefore rendered useless for policy design but also that the necessary budget that should be leveraged for such services is not enough and will lead to under-provision of water-related environmental services compared to what water users would prefer. This means that the expected economic benefits prior to action (estimated based on the valuation study results) could not fully translate into economic benefits after action. The fee charged to water users was instead decided through the voting of representatives from the different urban water sectors. In this case, the fee to be charged was decided based on political considerations over economic ones.

FIGURE 6

Economic benefits and costs from action from preventing land degradation
(adapted from Nkonya et al. 2011, pg. 4[38])



inaction developed by ZEF and IFPRI[25]. The reasoning for the deviation stems from the aforementioned fact that the costs of inaction will most likely overestimate the actual economic benefits that arise with action such as land restoration.

The costs and the benefits of adopting sustainable land management and alternative land-based economic activities depend upon the level of action taken and change achieved, which in turn depends upon the causes of land degradation and the processes driving it. Once both the costs and benefits derived from action have been estimated using the methods detailed in the previous sections, one can then estimate a net economic benefit from action that will be equal to the benefits minus the costs. It is important however, to consider both the economic costs and benefits from action in sound decision-making (*Case Study 7*).

It is also important to note that there is often not just one option, but several possible alternatives for action. For instance, investments could be made to improve productivity or alternative livelihoods

CASE STUDY 7

Increased cost-effectiveness when both benefits and costs are considered
(Naidoo and Iwamura 2007[55])

It is important to consider both the economic costs and benefits from action in sound decision-making. Naidoo and Iwamura (2007) calculated and mapped the annual gross economic rents of the world's cropping and grazing lands (i.e., the profits predominantly derived from food production). They identified areas where conservation would be most cost-effective, taking both biophysical benefits and economic costs into account, and compared them to existing conservation hot spots. They showed that only considering the benefits from conservation without considering the costs forgone (i.e., the lost profit from agricultural production) leads to suboptimal allocation of resources for conservation. Conversely, taking only the costs forgone but not the economic benefits of conservation into account would not be economically optimal either.

Moving one step beyond this study would involve the translation of the biophysical benefits in monetary terms, comparing them to the costs of conservation, and including economic activities other than those linked to the agricultural sector (e.g., tourism).

(such as arts/crafts and eco-tourism), or simply carrying on with business as usual ("changing nothing"). From an economically logical perspective, the option that leads to the greatest economic benefit should be the top choice. *Box 3* details an example of decision-making to identify an action to be implemented based on the level of economic gains to be made.

BOX 3

Calculation of the Total Economic Value

This box details an example of economic decisions based on land values for illustrative purposes. A comparison is drawn between two pieces of land which provide similar ecosystem services; one has many existing economic activities (*Land A*, e.g., at a city's periphery), and another only has a few existing economic activities (*Land B*, e.g., in rural areas). The information is summarised in *Table 5*. There are several decisions that can be derived from this comparative analysis:

1) *Choose* ***one option*** *that has the* ***greatest benefit between both*** *pieces of land:* invest in alternative livelihoods on Land B – the land with little existing economic activity, where one will get the greatest net economic benefit from action.

2) *Choose* ***one option*** *that has the* ***greatest benefit for both*** *pieces of land:* invest in productivity on the Land A – the land with many existing economic activities, and also in alternative livelihoods on Land B – the land with little existing economic activity.

3) *Choose* ***two options*** *that have* ***some benefits for both*** *pieces of land:* potentially invest in both land productivity in Land A and alternative livelihoods in Land B. The proportion of investment allocated between the two will depend upon overlap/trade-offs and the economies of scale and scope between the two options considered. Whether action needs to be prioritised between Land A and B also depends on the available budget that will trigger action on both pieces of land.

4) *Choose* ***at least one*** *option and adapt the broader environment:* the legal, political, social, and economic context can be adapted to allow for and/or foster action. Outreach and education activities can also complement this.

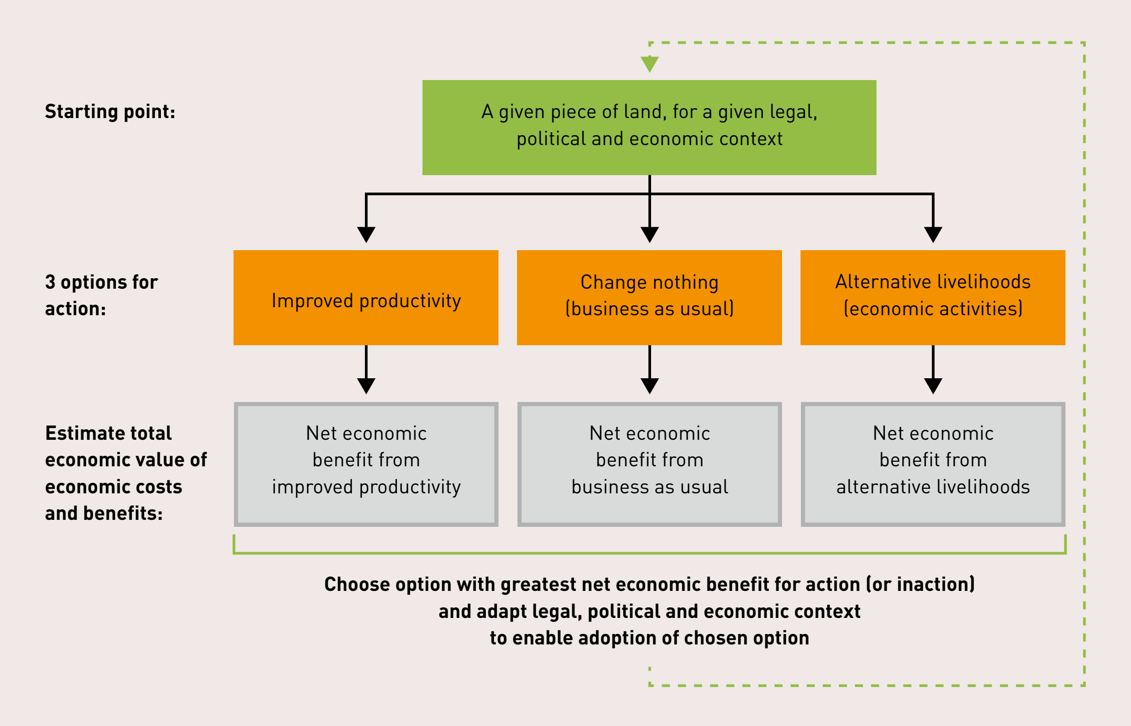
TABLE 5

Economic options for investments into land-based activities and results

Option for action	Economic cost of action	Economic benefit from action	*Net* economic benefit from action
Land A – Piece of land with many existing economic activities			
Change nothing (inaction)	USD 40	USD 30	– USD 10
Invest into productivity	USD 100	USD 120	+ USD 20
Invest into alternative livelihoods	USD 130	USD 140	+ USD 10
Land B – Piece of land with few existing economic activities			
Change nothing (inaction)	USD 60	USD 30	– USD 30
Invest into productivity	USD 20	USD 25	+ USD 5
Invest into alternative livelihoods	USD 50	USD 100	+ USD 50

FIGURE 7

A decision-making framework with net economic benefit as choice criterion (i.e., economic benefits minus costs)
(Source: report authors)



Following upon this, *Figure 7* provides a summary of the economic decision-making pathways to action. The costs and benefits associated with the three options for action (change nothing, invest into productivity, and invest into alternative livelihoods) are estimated to derive the net economic benefit from the action associated with each option (for the "change nothing" option, this is the economic benefit of inaction) and identify the option with the greatest net economic benefit. It is sometimes necessary to adapt the legal, political, and economic contexts in order to enable the adoption of the most economically desirable option, and also to remove existing barriers to adoption. The same approach can be repeated as many times as necessary for the same (improved) piece of land until the economic gains are exhausted. The main advantage of this approach is that is allows for a consideration of the agricultural sector. Agriculture is a key sector in addressing our food security issues as we need to produce more food, and ensure global food security and access. However, part of managing land more sustainably is reducing human pressures on land currently exploited for agriculture. One option could be to foster the uptake of alternative livelihood options by poor farmers in such areas, so that land can become more sustainably managed and poor farmers can maintain or expand their income levels. This approach would allow us to go beyond the agricultural sector and consider other economic sectors that are linked to alternative livelihoods (e.g., tourism, conservation). Alternative livelihood options like this should be an integral part of strategies addressing land degradation and sustainable land management. There are quite a few options and pathways for action (*Box 4*) and the choices to be implemented for effective land management depends on specific contexts with given technical, political, legal, cultural, social, and environmental conditions.

BOX 4

Options and pathways for action

There are a range of possible practical options and pathways where sustainable land management is tied in with increased economic viability for the greatest net social and economic profit. The following options are commonly found in the existing literature.

Adoption of alternative land management

These can refer to the adoption of more sustainable agricultural practices to improve agricultural yields and livestock production, afforestation/reforestation to control water flows, etc. Alternative land management detailed in the literature is advocated as providing greater economic benefits than associated costs. These profits often materialise though increased revenues as a result of increased production, certification schemes (e.g., FairTrade Foundation®), increased land market prices (e.g., land rents[11]), reduction of droughts, flood occurrences, etc. Increased benefits usually accrue directly to stakeholders and generally require access to the right information for the implementation of change.

Establishment of alternative livelihoods

A typical example would be the establishment of eco-tourism activities that contribute directly to conservation efforts and practices[56,57,58,59], or fair trade production of arts and crafts. Stakeholders usually reap benefits directly, but this requires access to information and resources in order to develop the facilities, skills, and capacity required to establish market routes to potential customers and undertake advertisement campaigns to promote these alternative livelihood activities.

Establishment of payment for ecosystem service schemes

Land managers are rewarded for conserving ecosystem services for those who use them[45,60,61,62,63,64]. The stakeholders usually reap the benefits directly, but this requires access to information, and national or international redistribution mechanisms to ensure payments. This can include payments to store carbon or to preserve biodiversity. The United Nations Reducing Emissions from Deforestation and Forest Degradation (REDD) programme is an effort to offer incentives to developing countries to reduce emissions from forested lands and invest in low-carbon paths to sustainable development through the creation of a financial value for the carbon stored in forests. Another programme, REDD+, goes even beyond deforestation and forest degradation to include the role of conservation, sustainable management of forests, and the enhancement of forest carbon stocks. Additionally, private companies (e.g., Vittel Water®, Hydroplants) or NGOs (World Wildlife Fund in Kenya) might pay land users for ecosystem services.

Establishment of new markets for ecosystem services: carbon storage and sequestration

Within most markets, most ecosystem services have no or little value assigned to them. A specialised payment for ecosystem services works within the market scheme to create the potential to assign monetary values to services previously not or under-valued[65]. This goes beyond payments for ecosystem services by letting the price for carbon be determined through a market. This can directly benefit stakeholders, but depends on the fluctuations in the market price and could lead to a switch in land management strategies by stakeholders. It also requires monitoring of the market operation, and some financial speculation. Examples of new market establishment include the carbon market in Europe and China.

Provision of subsidy schemes

These involve government action and can target a range of stakeholders such as farmers or small land holders. They can be provided on a one-off basis to lower establishment or switching costs (e.g., the UNDP/GEF Small Grants Programme[66]), or linked to land use or type of production in order to lower costs of operation (e.g., United States and European Union agricultural policies). It requires both stakeholder access to information and the targeting of stakeholders by donors. The maintenance of a subsidy scheme in the long term usually requires strong lobbying from interest groups.

Establishment of taxes

Taxes aim to raise the cost of production or consumption of environmentally damaging goods, thereby reducing or limiting demand for these goods, and thus reducing or limiting the environmental damage. It involves government action and monitoring and social acceptance of these taxes. An example of this is the eco-tax in Europe on plastic-based products, which then directly funds their recycling.

Implementation of bans
These require strong government action and monitoring and can be costly to enforce. An example of this is in Rwanda, where plastic bags are banned to reduce environmental pollution.

Provision of opportunities to make voluntary payments for environmental conservation or offset
An example of this is voluntary payments to offset carbon consumption, or the provision of monetary support to environmental conservation charities and non-governmental organisations, which are currently being promoted by some airline and train organisations.

Provision of microfinance
Microfinance focuses on promoting local, small-scale business establishments. Credit facilities are provided at a lower interest rate than those offered by traditional banking establishments, who consider these initiatives as too small or too risky. Microfinancing is seen by economists as a good alternative to subsidies which tend to have adverse consequences on society and behaviours[67]. Access to microfinance has successfully contributed to poverty reduction in Bangladesh at the individual level (especially for women), as well as at the village level[68]. Recent evidence suggests that access to microfinance is not sufficient on its own to lead to improvements in health, education, and women's empowerment[42,69], but it is an integral part of the "action option mix" to promote sustainable land management.

Establishment of research, policy, and stakeholder networks and platforms for exchange
The development of networks and platforms leads to greater information exchange between local stakeholders and decision-makers, as well as increasing the scientific basis for informed decision-making[70].

Improving data availability
The current spatial variations in data availability impair scientific research activities and active international communications[71]. Data availability depends on the wealth level (per capital GDP), language (English), security level, and geographical location in relation to the country. Through scientific education, communication, research, and collaboration, data availability can be improved by building capacity in low-GDP countries with fewer English speakers that are located far from the Western countries that host global databases, and in countries that have experienced conflict.

*The **pathways** to the provision of these **options** rely mostly on the policy-making process and government action, and can provide direct benefits to private stakeholders. The provision of funding from external donors or private investors depends on their incentives to do so (which may change over time), but private investors will act if they can be convinced that they will get a return on their investment. Short term funding will be effective in promoting change if it lowers financial barriers to change.*

Six steps to estimate the economic benefits and costs of action, and one to take action

The approaches, frameworks, and methods detailed in previous sections have been summed up into a 6-step methodology conceptualised by the Global Mechanism of the UNCCD [52] and further developed by Noel and Soussan (2010) [49] for the OSLO Consortium, with each step further disaggregated as required in order to meet the specific objectives of individual studies:

1. **Inception:** Identification of the scope, location, spatial scale, and strategic focus of the study, based on stakeholder consultation and the preparation of background materials on the socio-economic and environmental context of the assessment.

2. **Geographical characteristics:** Assessment of the quantity, spatial distribution, and ecological characteristics of land cover types, categorised into agro-ecological zones and analysed through the use of a Geographical Information System (GIS).

3. **Types of ecosystem services:** Analysis of ecosystems services stocks and flows for each land cover category, based on the ecosystem service framework.

4. **Role of ecosystem services and economic valuation:** The role of the assessed ecosystems services in the livelihoods of communities living in each land cover area, and also the role of overall economic development in the study zone. This implies estimating the total economic value of these services to estimate the benefits of action or the cost of inaction.

5. **Patterns and pressures:** Identification of land degradation patterns, drivers, and pressures on the sustainable management of land resources, including their spatial distribution and the assessment of the factors causing the degradation. This is to inform the development of scenarios for cost-benefit analysis. The following sub-steps can be taken to choose the appropriate valuation method under available data, resources, local capacity, and specific objective to be achieved: (a) deciding the type of environmental problem to be analysed; (b) reviewing which valuation method is appropriate for that problem and the type of environmental value to be captured (use value or total economic value); (c) considering what information is required for the identified environmental problem and chosen valuation method, and; (d) assessing what information is readily available, how long it would take to access it, and at what monetary cost.

6. **Cost-benefit analysis and decision-making:** The assessment of sustainable land management options that have the potential to reduce or remove degradation pressures, including the analysis of their economic viability and the identification of the locations for which they are suitable.

7. **Take action:** Implement the most economically desirable option(s). This may require adapting the legal, political, and economic contexts to enable the adoption of most economically desirable option(s), and removing existing barriers to adoption.

A range of tools have been released for mapping ecosystem services, such as the Natural Capital Project's Integrated Valuation of Environmental Services and Tradeoffs (InVEST) tool or the ARtificial Intelligence for Ecosystem Services (ARIES) modelling platform. These tools aim to help map ecosystem service provision and model their evolution with time, associate them to an economic value, identify scenarios, and help decision-makers assess trade-offs between these scenarios for informed decision-making. GLUES (Global Assessment of Land Use Dynamics, Greenhouse Gas Emissions and Ecosystem Services) is a project led by the German Ministry of Education and Research that publicly shares datasets and data related to sustainable land management and optimal use of land and land services. The Australian INFFER (Investment Framework for Environmental Resources) is a privately operated system that aims to develop and prioritise projects addressing environmental issues such as reduced water quality, biodiversity, environmental pests, and land degradation. MIMES (Multiscale Integrated Models of Ecosystem Services) [72] is an initiative lead by the University of Vermont which also aims to evaluate ecosystem services. All of these tools can in theory produce results for various levels of available data but with a level of uncertainty that decreases with the level of available data.

The drivers of land degradation have been described by Geist and Lambin[73], and further elaborated by Nkonya et al.[74]. Indications of the data and potential sources required to identify these drivers is included in Appendix 2.

Other economic approaches

There are other economic approaches which adopt a slightly different but complementary perspective to cost-benefit analysis.

Shadow interest rate

The shadow interest rate is similar to the rate of interest charged by banks for loans, and is applied to the natural capital we borrow from future generations. It is the interest that society as a whole pays for not managing natural resources sustainably. The lower the shadow interest rate, the more sustainable the management pathway will be. *Case Study 8* is an example of this, showing that fishers who overfish the stocks end up borrowing natural capital at much higher rates than they would pay to borrow money in a bank (at a typical 6% rate of interest).

The shadow interest rate concept can be applied directly to a land management context, and is one way of communicating effectively with a private sector driven by economic goals and comprehension.

Multi-criteria analysis

Multi-criteria analysis, also called multi-criteria decision analysis, is a semi-qualitative procedure used to compare or determine overall preferences between alternative and often conflicting options. It helps identify a preferred option in multi-disciplinary contexts without requiring preliminary consensus between stakeholders on how costs and benefits will be measured.

Multi-criteria analyses assess options (scenarios) along several quantified or scored criteria (attributes). Assessment criteria can be quantitative or qualitative (scores) and can relate to social, technical, environmental, economic, and financial changes. It is an easy tool to use and has a wider scope than cost-benefit analyses because it includes qualitative as well as quantitative data.

CASE STUDY 8

Shadow interest rate: Europe *(Quaas et al. 2012[75])*

"'We borrow the earth from our children,' environmentalists say – but at what rate of interest?"

Fish stocks can be considered a natural capital stock that provides harvestable fish. Overfishing from these stocks means borrowing from the natural asset. While fishing for a particular quantity above the sustainable population threshold generates immediate profits and income, an interest rate has to be paid in terms of foregone future fishing income, as the fish stock's reproductive capacity will remain low, and fishing costs will remain high. The concept of the shadow interest rate can be interpreted as the interest that has to be paid by fishermen in future years on the fishing income earned this year. It can quantify the degree of overfishing and make its economic consequences transparent, as well as evaluate the profitability of short-term catch reductions as investments in long-term natural capital stocks. It also quantifies the economic return on reducing the catch to just slightly below a given (sustainable) value. Accordingly, such a catch reduction can be regarded as an investment in the natural capital stock. The shadow interest rate incorporates the relevant biological and economic information and can be used to compare fish stocks. The shadow interest rates were computed for 13 major European fish stocks, and range from 10% to more than 200%. This means that fishers pay considerable interest when mismanaging fish stocks. Recent management improvements and catch reduction (e.g., in the Eastern Baltic cod or North Sea herring fisheries) have led to a decrease in the shadow interest rates in recent years, indicating greater economic returns. Fishers would thus benefit from managing the fish stocks more sustainably.

The difference in rate of interest paid was graphically highlighted in this study on a map with fish shapes proportional to the rate of interest for each fish stock.

Multi-criteria analysis is not an environmental valuation method, but rather helps to identify preferred scenarios without using economic valuation techniques. This analysis tends to be adopted as an alternative to cost-benefit analyses when decision-making is influenced by political rather than economic forces. However, this method has limits: there is a risk of double-counting for overlapping objectives, it relies on expert judgement which does not always correspond to the preferences of society as a whole, and the scoring of qualitative impacts can be arbitrary in some cases. Furthermore, it is subject to small sample biases which arise when the sample is too small to allow for proportional extrapolation to an entire population, which can make it difficult to derive a scenario that would be acceptable to all groups.

A multi-criteria analysis does not always translate into economically sound decisions compared to a cost-benefit analysis[76] and a cost-benefit analysis should be preferred. In certain situations however, it may constitute a more acceptable exercise to stakeholders. It can also be used as a preliminary screening to environmental valuations that analyses scenarios and identifies a preferred choice and criteria that can then be more formally economically valued.

Macro-economic approaches

The approaches detailed in previous sections focus on estimating potential flows of money within society or changes in existing monetary flows to make them match on economically and socially optimal levels. As such, they are micro-economic approaches.

On the other hand, macro-economic approaches focus on government macro-economic accounting at the national or regional level to estimate indicators similar to the GDP, while taking the environment into account. The objective of macro-economic analyses is therefore different from that of micro-economic analyses which use economic valuation and cost-benefit analysis to assess whether action is economically worth doing or not. Because of this difference in objective, macro-economic approaches can be used as complement to the micro-economic approach and frameworks detailed above and used for the ELD Initiative.

Examples of macro-economic approaches include the UN System of Environmental-Economic Accounting (SEEA), which describes stocks and changes in stocks of environmental assets, and the Wealth Accounting and the Valuation of Ecosystem Services (WAVES) global partnership, which provides a method for natural capital and national ecosystem accounting. Due to their focus on improving national accounting methods by including economic values of environmental goods and services, these macro-economics approaches focus on use values only. These use values are mostly measured through non demand-based methods (market price, replacement costs, dose-response methods, damage cost avoided, mitigation costs, and opportunity costs).

Condition for improved decision-making

The appropriate technical, political, legal, cultural, social, and environmental conditions are needed to ensure the successful implementation of economic action and instruments for long-term sustainability. The most economically desirable option has to be technically and legally feasible, and environmentally and socially acceptable. Additionally, physical and monetary resources to achieve the practical implementation of sustainable land management should be accessible and available.

BOX 5

Examples of adaptations to facilitate and foster action

- Formalise informal property rights regimes and allocation and change them if necessary to promote improved land management[77]
- Provide some microfinance scheme to promote access to monetary capital to small holders[80]
- Implement a payment for ecosystem services scheme[81]
- Conduct local consultation[82] through participatory valuation and policy-making
- Remove institutional constraints
- Consider gender aspects

Economic sustainability of land use and land-based economic activities depends on how the **property rights** for these land uses are allocated and formally recognised, with both the type of property right owner (open access, individual property, common property) and the type of use (cropping and planting, passage on the land, passage in the air over the land) formally recognised[77]. When customary property rights are not formally registered, they can be easily ignored or overlooked by governments or international investors to the detriment of local and poorer populations, and leading to social unrest. Establishing formally recognised land registers and enforcing individual and collective property rights can help to identify the appropriate stakeholder(s) who should be taking action against land degradation or be receiving compensation when property rights are transferred to another land manager (e.g., foreign investors). The FAO has already established a set of voluntary guidelines regarding responsible governance and land tenure, which could act as a policy template or blueprint for governments, policy-makers, and practitioners in determining what constitutes acceptable or fair practices for all[78].

Legal systems need to recognise total economic valuation as a principle for sound decision-making and action. Unless total economic values and property right ownerships are recognised by legal systems and compensation is provided to those who depend on the land, it will be difficult to avoid social unrest[79]. This is even more so the case when international investors, perceived as 'rich' by the local populations, are involved.

Education and outreach activities may also be required to provide access to information at the local level. Physical, technical, and monetary resources should also be made available at the local level to ensure action is effectively taken. A lack of access to these resources and information about sustainable land management is particularly acute in Sub-Saharan African countries.

The most important condition for success is to **establish discussions** and identify win-win options between all stakeholders, including local populations and their representatives. This is referred to as a "participatory" approach, and can be applied to methods used to derive economic values. This process considers the opinions of stakeholders to be on an equal footing regardless of their bargaining power and thereby goes beyond mere consultation.

The 6 (plus 1) steps build a process that takes a range of informed actions from economic valuations and scenario-building suited to specific social, political, legal, and economic contexts. The focus on the total economic value of economic benefits from action will help assess the potential gains for society from adopting sustainable land management through improved agricultural production or the provision of alternative livelihoods. This process builds upon previous initiatives and partnerships with parallel initiatives. The remaining challenge is to translate existing academic methods into pragmatic applications for wider practice, by building stakeholders' capacity to gather this information and then take informed action.

Sampling method for extrapolation of existing case studies and global comparison

One of the problems faced by the initiative is how to scale up local estimates of the costs of land degradation or economic benefits from sustainable land management estimated for specific case studies to derive global estimates. To tackle this issue, a solution is to group case studies based on identified characteristics, which can be accomplished by several methods.

The first option is to use a **methodology based on the drivers of land degradation**. This is the approach taken by ZEF and IFPRI, who have developed a three-step sampling strategy for grouping case studies based on the drivers of land degradation. This is to ensure that the analysis can be extrapolated to a global context in an accurate and relevant manner. The first step aims to group countries of the world based on their socio-economic and institutional underlying factors of land degradation by: GDP per capita, government effectiveness, population density, and agricultural intensification[25]. The second step is to check that the groups of countries are valid, by verifying that the following are different between groups: other socio-economic and biophysical indicators of land degradation, share of rural population, share of agriculture in GDP, and average cereal yields per ha. An example of the heterogeneity in the groups can be seen in *Table 6*. These first two steps ensure that the case studies selected are representative of global heterogeneity in terms of socio-economic,

TABLE 6

Clustering and validation results
(Nkonya et al. 2013[26], Table 1, pg. 13)

Clusters	GDP per capita	Government effectiveness	Population density	Agricultural intensification	Maximum changes in normalised differenced vegetation index values between the baseline (1982–84) and endline (2003–06)	Cereal yields	Share of agriculture in GDP	Share of rural population in total
1	lower	lower	higher	lower	highest dispersion, both biggest decreases and increases	lower	higher	higher
2	mid	mid	higher	higher	smaller decreases	mid	mid	higher
3	mid	mid	higher	mid	smaller decreases	mid	mid	mid
4	mid	mid	lower	mid	larger decreases	mid	mid	lower
5	mid	mid	lower	lower	smaller decreases	lower	mid	mid
6	higher	higher	mid	higher	larger decreases	mid	mid	lower
7	higher	higher	higher	higher	smaller decreases	higher	lower	lower

BOX 6

Criteria for selection of case studies to be commissioned by the ELD Initiative

Proposals have been evaluated according to the following criteria:

(a) scientific quality and "value for money"

(b) use of top-down or bottom-up approaches, or innovative aspects of both

(c) use of non-market valuations as well as market valuations

(d) potential for integration of results across scales

(e) consideration of land rehabilitation, prevention of land degradation, and alternative livelihoods for action

(f) capacity to involve and/or reach out to a range of audiences (scientific community, decision-makers, private sector)

(g) selected location(s) is (are) representative of its (their) specific region(s) of the World

(h) addresses one or more of the identified gaps (See *Box 9*)

(i) well-defined time plan and adequate proposed budget

institutional, and land degradation characteristics.

The third step is to choose countries from each group to commission new in-depth case studies, based on regional representativeness, existing data, and/or data being collected. This driver-of-land-degradation-based approach is most relevant when the drivers are addressed directly (e.g., to reduce agricultural land erosion).

Alternatively a **methodology based on the type of objective to be achieved** can be used when alternative livelihood options are being considered as the action. In this case, the driver-based method is limited and a similar method based on objectives rather than drivers may be more appropriate. For instance, the drivers of land degradation will not inform the setting up of eco-tourism as much as other economic factors such as access to the location, flora and fauna, risk of kidnapping, political stability, etc. This amounts to grouping relevant case studies by the ecosystem service of interest for statistical analysis to ensure that the findings can be extrapolated to a global context.

Method to assess the relevance of existing case studies and commissioning new case studies

Moving forward from the methodologies discussed in this chapter, the ELD case studies presented in Chapter 3 are categorised so as to facilitate the future identification of relevant case studies and analyses by the ELD Initiative working groups, depending on specific objectives (e.g., increasing agricultural productivity or setting up new economic activities). The literature has been categorised by: world region, type of ecosystems, type of ecosystem service (food, fibres, carbon storage, tourism, amenity, etc.), type of economic value, and type of valuation method (when applicable). They have also been allocated to one or more of the ELD working groups (*Data and Methodology, Scenarios,* and *Options and Pathways for action*).

The selection of new case studies commissioned by the ELD Initiative was made based on knowledge and practice gaps, so to ensure a comprehensive geographical and thematic scope (*Box 6* and *9*).

CHAPTER

03

Existing case studies on the economics of land degradation and sustainable land management: The known and unknown (preliminary results)

This report re-emphasises the conclusions of previous reviews that there are insufficient case studies to draw definitive conclusions on the economics of land degradation mainly because there have been no comprehensive studies on the total economic value of land. First estimates indicated that the costs of land degradation were in the order of 3–7% (up to a maximum of perhaps 10%) of agricultural productivity[83], with the cost of remedial action being an order of magnitude less than the costs of degradation. Other estimates indicate costs of environmental degradation to be of the order of 4–8% of GDP in developing countries, 2–7% of GDP in North African and West Asian dryland countries[84], and 3.3–7.5% of global GDP[85]. A review by Nkonya et al.[38] in 2011 showed that, in general, the costs of taking action to prevent/reverse land degradation were less than the costs of not taking action. Nkonya et al. 2011 also showed that there is a global loss of arable land per capita to the order of 40–50 m^2 per year[74]. For the 2 billion people living in drylands this can amount to a loss of 8–10 million ha per year. The value of drylands has recently been estimated to range from USD 101–5,640 per ha[86], meaning a loss of value to the order of USD 0.8–56.4 billion per year from land degradation in drylands. These figures are probably underestimated because the values were not based on total economic values, but rather on what each particular study had measured in terms of ecosystem services. The estimates are thus of a similar order of magnitude to global estimates of costs of desertification of USD 42 billion per year, amongst others[87,88].

> **Our doubts are traitors, and make us lose the good we oft might win by fearing to attempt.**
>
> *William Shakespeare, Measure for Measure (Act 1, Scene 4) 1603*

To address the deficiencies in data, the ELD Initiative sent out a call for existing case studies that reflected research on and analyses of the economics of land degradation. The received case studies were complemented by additional literature searches, with over 200 studies referenced. This list is non-exhaustive and is being expanded and updated continuously. The preliminary analysis below is based on the first 186 resources referenced, of which 121 were identified as case studies, and the other 65 as reviews and theoretical frameworks. Within these preliminary results, several trends were revealed.

Heightened interest in land value after the food crises, in relation to addressing food security issues

Temporally, most research related to the economics of land degradation has taken place over the past 5 years (*Figure 8*). This coincides with the first food price spikes and the pioneering use of economics for global assessments of environmental action by the Stern Review on Climate Change (2007)[53].

A need for capacity building in Africa, Asia, Central and South America

Case studies were further broken down into their world region, in order to determine if there are particular zones that were being targeted for analysis on the economics of land degradation more than others (*Figure 9*). Most studies tended to focus on Africa or Asia, or had a global context, whereas the Americas, Oceania, and Europe had relatively few studies by comparison. This demonstrates a generally predominant focus on developing regions (excluding areas like Oceania, which are considered developing states, but have proportionally lower populations).

However, close to two thirds of the study authors were based in developed country regions. This reflects the fact that environmental economic valuation methods have primarily been developed in developed countries, as well the lack of academic and institutional capacity in developing countries in order for them to undertake valuation studies

FIGURE 8

Recent interest in land-related publication, in line with food security issues

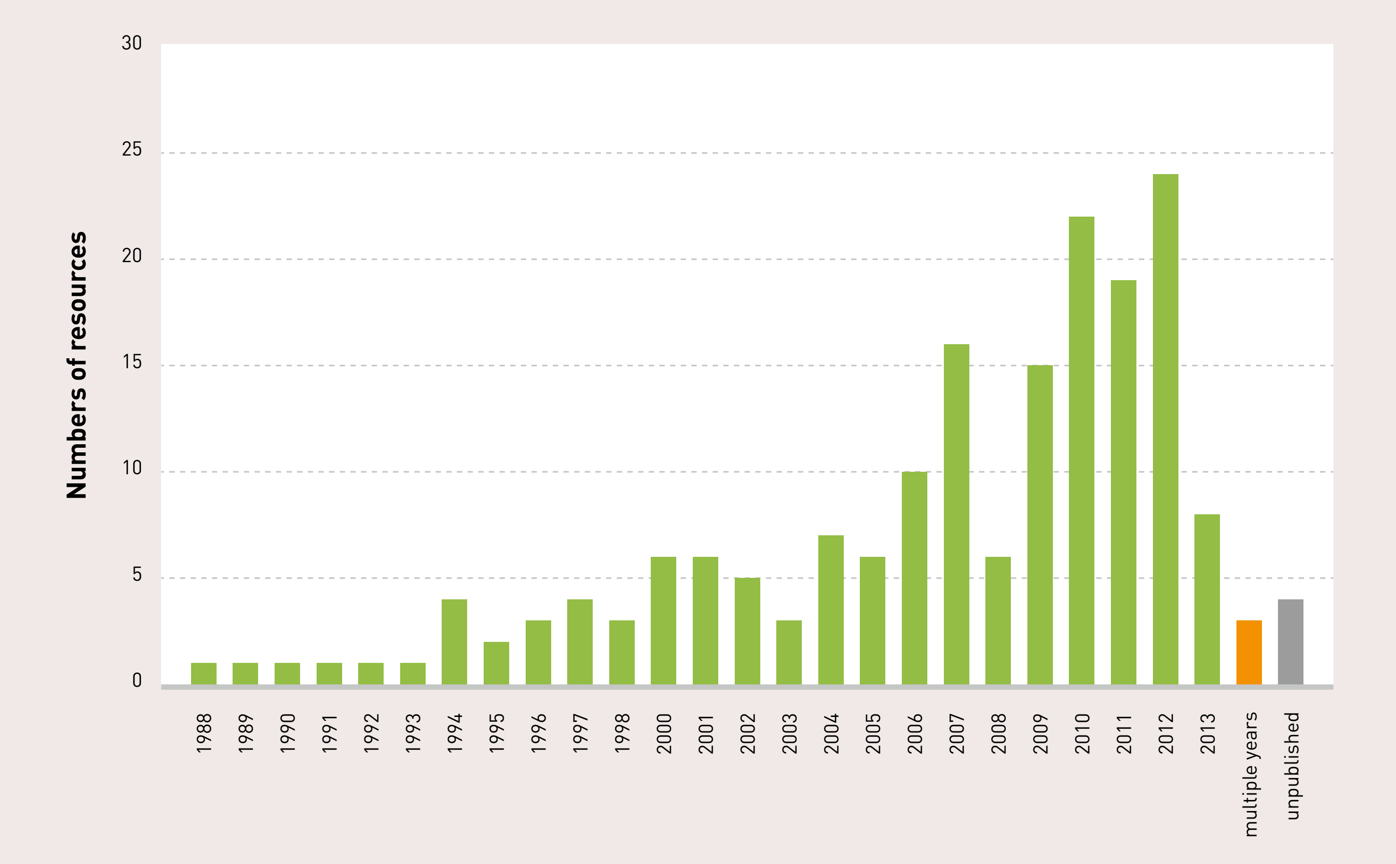
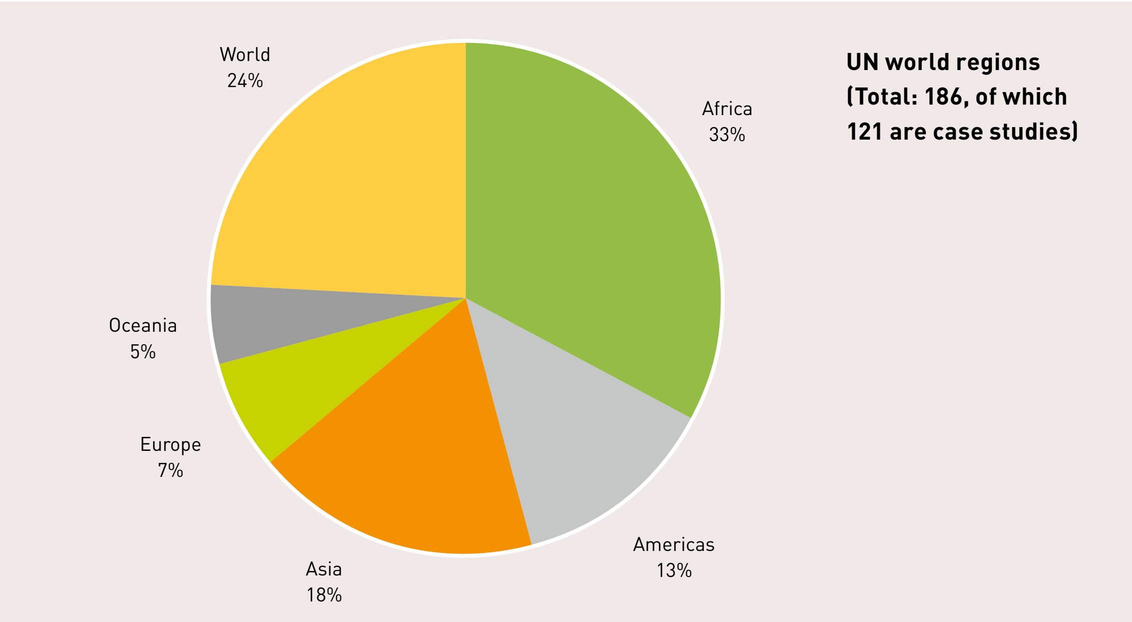


FIGURE 9

Geographic division of resources



BOX 7

Issues faced when implementing valuation techniques in developing countries
(from Christie et al. 2008[89])

The focus of this study is on biodiversity, but the same points apply to land valuation.

Methodological issues:

- Low levels of literacy, education, and language skills creates barriers to valuing complex environmental goods, as well as creating difficulties for using traditional survey techniques like questionnaires and interviews. More deliberative and participatory approaches to data collection may overcome these issues.
- Many developing countries have informal or subsistence economies, in which people may have little or no experience of dealing with money. The consequence of this is that they would find it extremely difficult to place a monetary value on a complex environmental good.
- Most of the methods reviewed have been developed and refined by researchers from developed counties. There is evidence that the current best-practice guidelines for these methods might not be appropriate for applications in developing countries.

Practical issues:

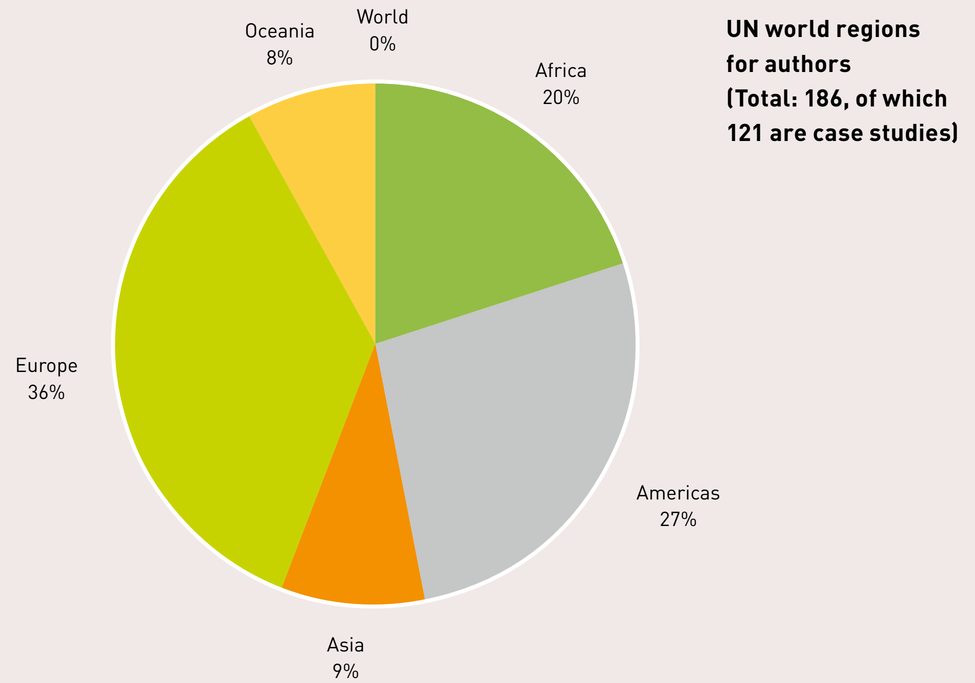
- Many developing countries are affected by extreme environmental conditions which may affect the researcher's ability to access areas or effectively undertake research.
- In many developing countries there may be a lack of local research capacity to design, administer, and analyse research projects. However, the involvement of local people is considered essential within the research process to ensure that local nuances/values are accounted for.
- There is some evidence that it may be easier to administer valuation studies in developing countries as: response rates are typically higher; respondents are receptive to listening and considering questions posed; and interviewers are relatively inexpensive (allowing for larger sample sizes).

Policy issues:

- The lack of local research capacity in many developing countries may result in a lack of awareness of valuation methods and of the importance of natural assets (e.g., land or biodiversity) to people. A capacity building programme focused on these issues is important if developing countries are to effectively address environmental issues.
- The lack of empirical valuation studies in developing countries is an issue when trying to effectively illustrate the importance of natural assets to people and for future input into benefits transfer.
- Much of the existing valuation research on the management of natural assets has been extractive, with little input or influence on local policy. Incorporating ideas from action research into valuation is essential if this type of research is to meaningfully influence policy.

FIGURE 10

Geographic location of authors



themselves (*Box 7*). Furthermore, 47 studies (26%) had authors based out of at least two different world regions (*Figure 10*).

A need to progress beyond use value and the agricultural sector

Most valuation studies have focused on estimating the use value of agricultural production, i.e., food and to a lesser extent, raw materials. This almost exclusive focus on use value and agricultural production (which periodically includes tourism) is well illustrated by the case studies undertaken by ZEF and IFPRI[38]. In their study of 5 countries and 8 production systems, the losses of crop production were used to estimate costs of action against various land degradation processes versus no action. In 7 of the 8 cases, the costs of action were less than the costs of inaction, ranging from 11–90%. However, all studies recognise that economics based solely on crop losses from land degradation misses important un-quantified benefits of other ecosystem services.

These case studies demonstrate a need to move beyond use value and consider the total economic value of land, as well as alternative livelihood potential (*Figure 13*). Land may be too degraded to be economically worth restoring for agricultural production, but may still be viable for other uses (e.g., to build tourist accommodations or act as buffer zone for water pollution regulation). The agricultural sector plays a great role in land values because of food security issues, but it is important to consider a broader, more comprehensive picture to make the most of land's full economic potential.

Economic valuation methods have been so far implemented in relation to their perceived ease-of-use, which does not always reflect how easy the methods actually are to use (*Figure 13*). However, for each ecosystem and ecosystem service, there is at least one available starting point from which inspiration can be drawn (*Figure 11*, *Figure 12*, and *Figure 13*).

FIGURE 11

Proportion of resources for each ecosystem

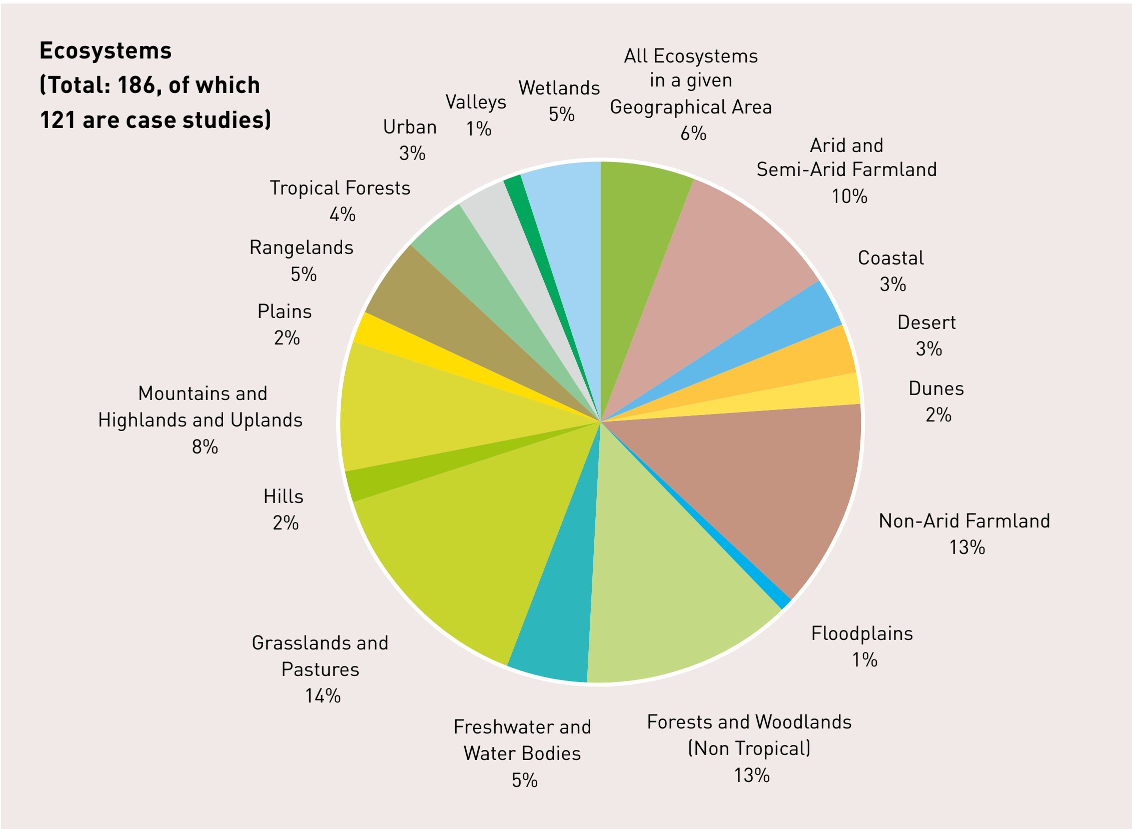


FIGURE 12

Number of resources for each ecosystem service

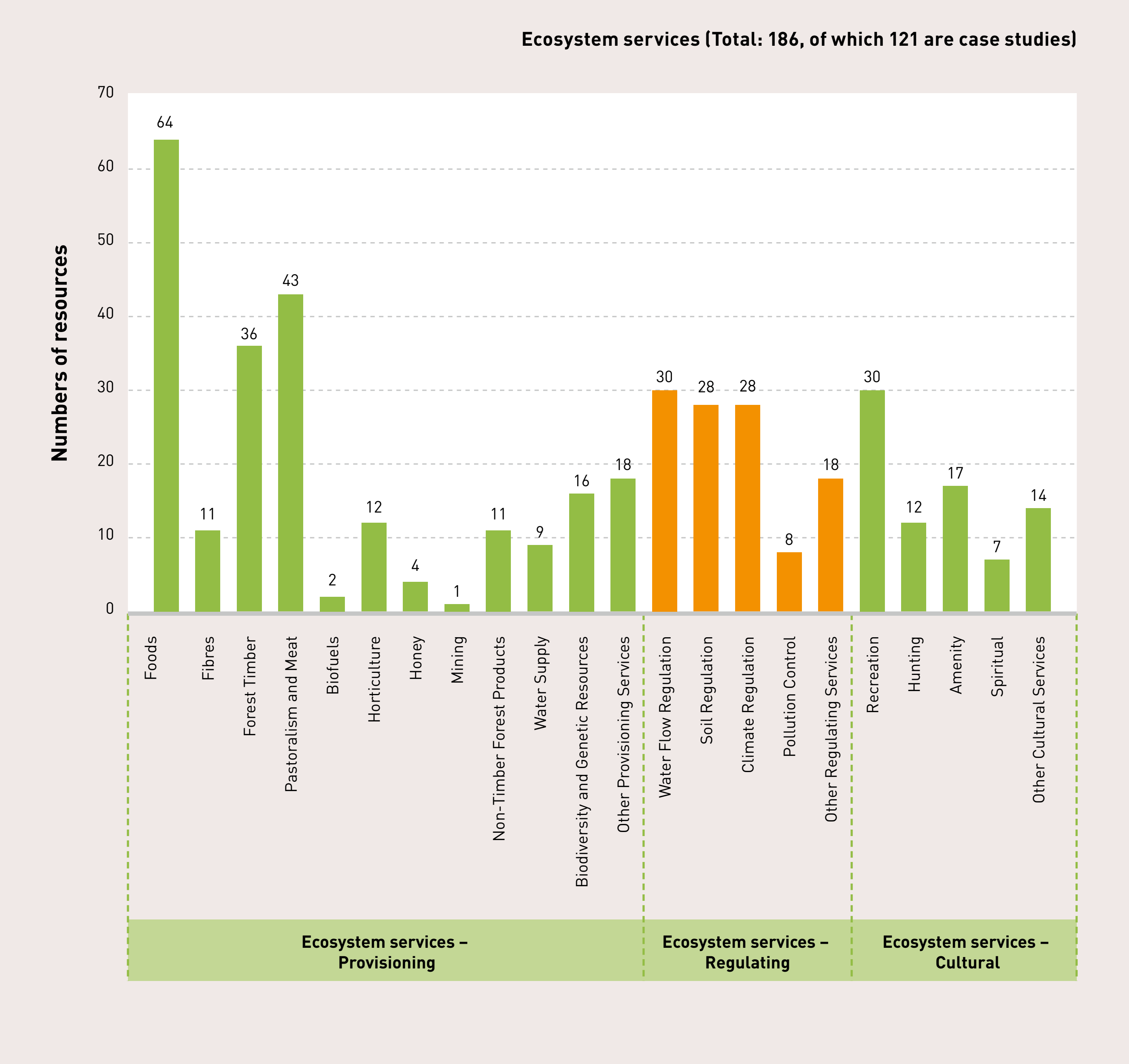
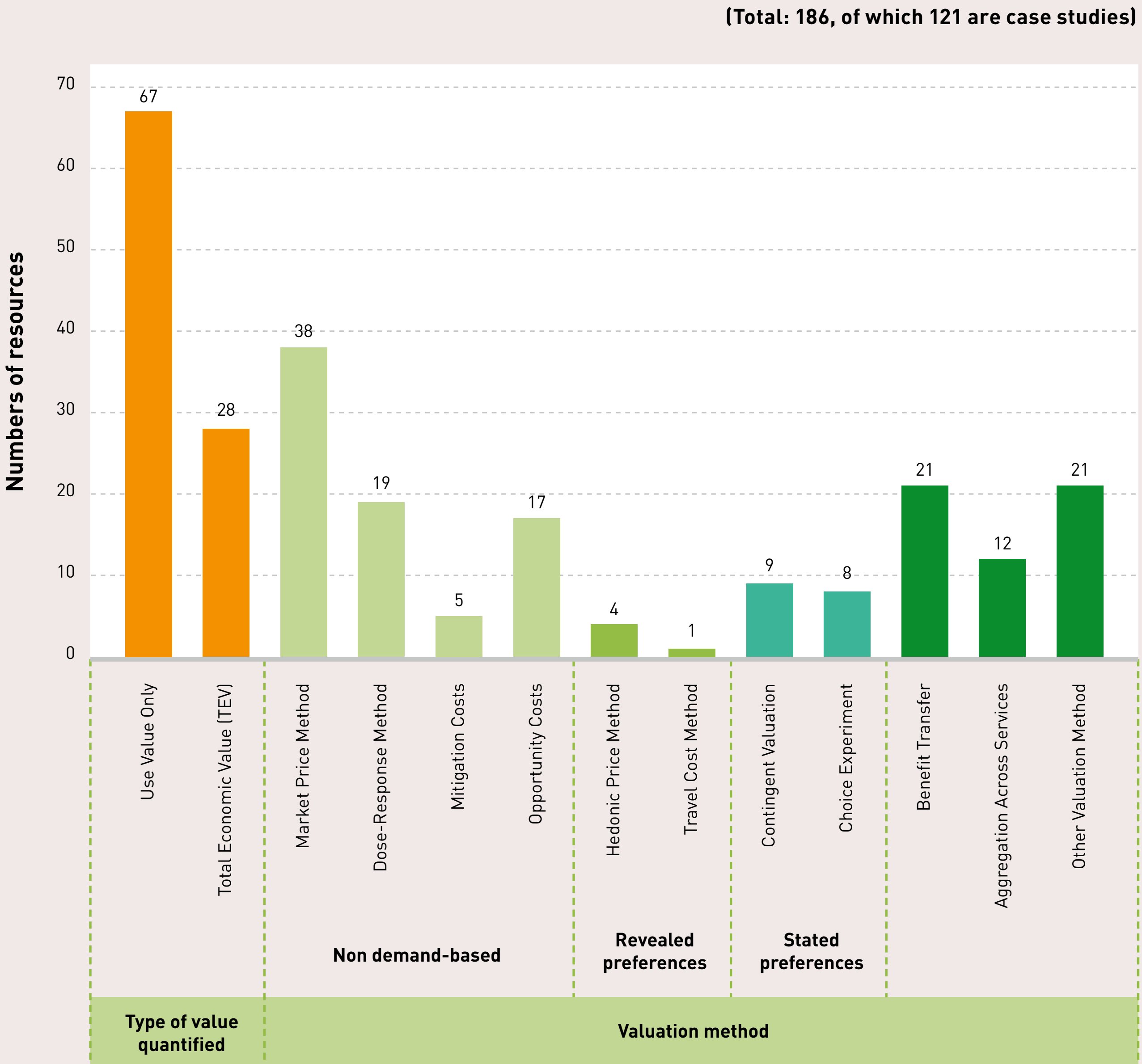


FIGURE 13

Number of resources for each quantified value and valuation method



** Aggregation across services is a specific form of benefit transfer which takes trade-offs into account*

FIGURE 14

Division of resources across the ELD working groups

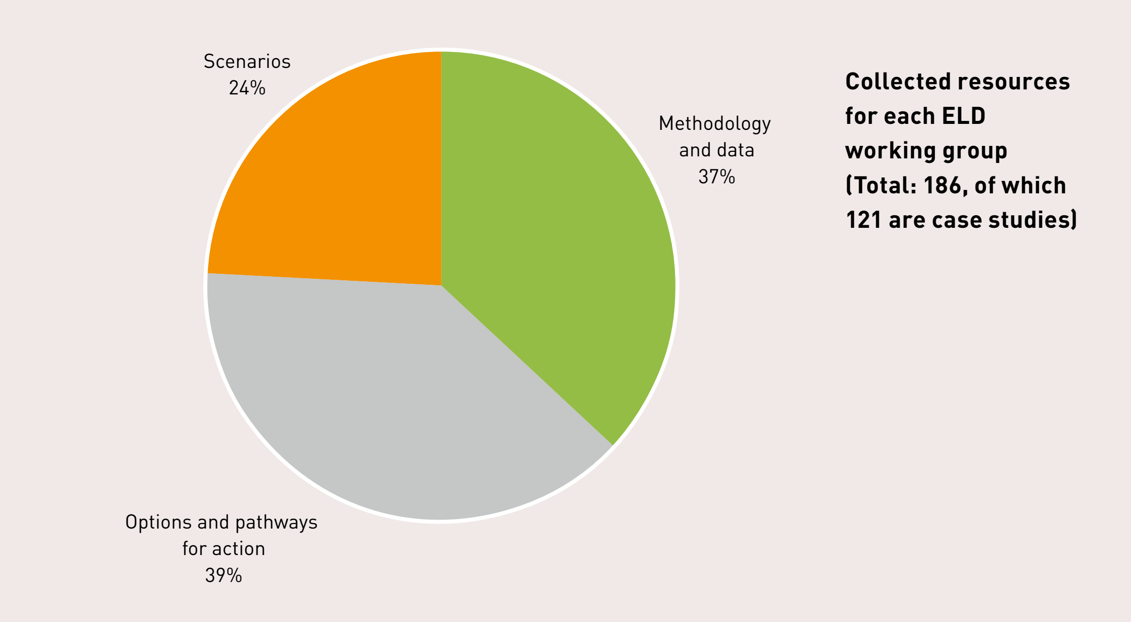
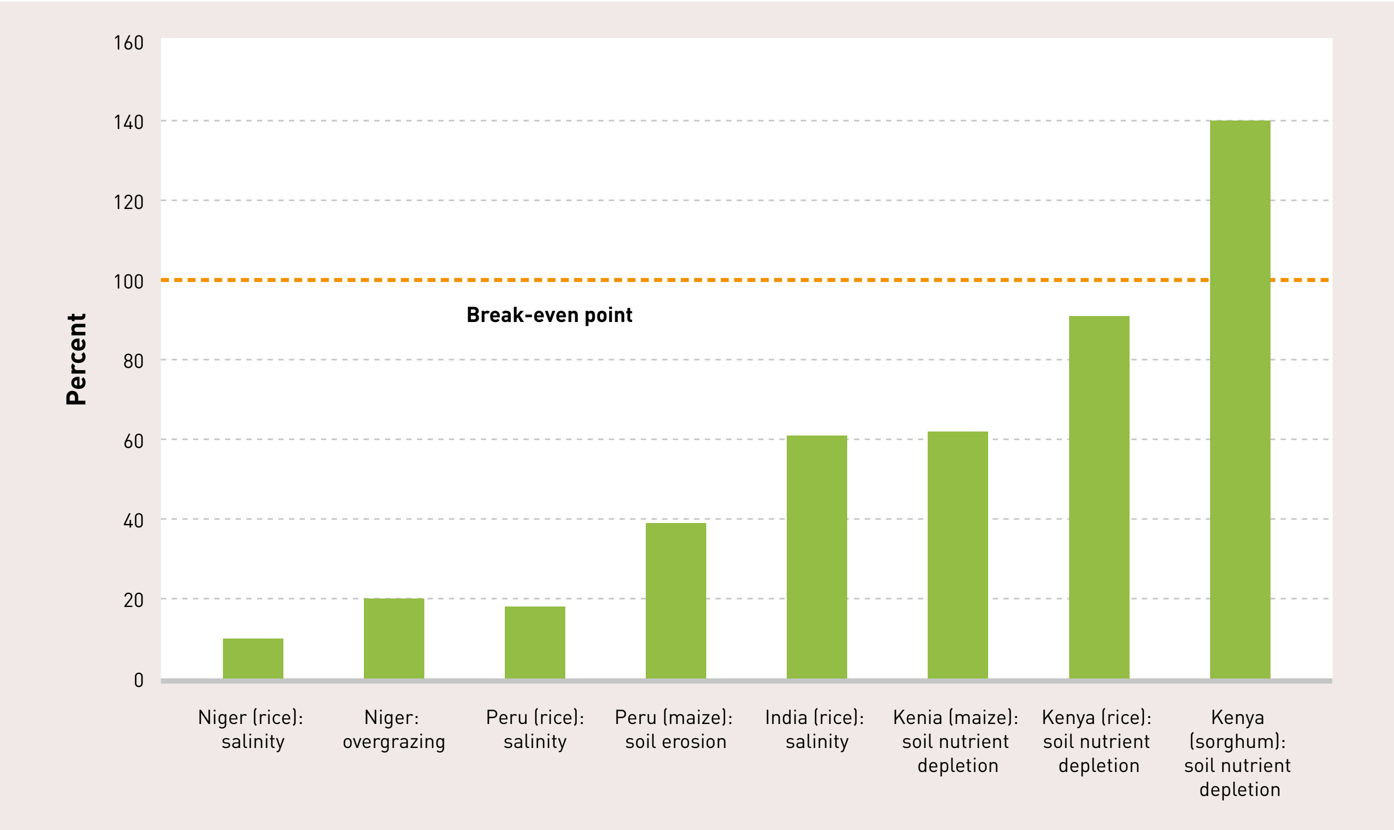


FIGURE 15

Cost of action as a % of cost of inaction – case studies
(von Braun et al. 2013 [11])



Application of the ELD Initiative framework

In terms of the ELD Initiative framework, the resources collected and analysed thus far are fairly equitably distributed across the 3 ELD working groups on *Data and Methodology, Scenarios*, and *Options and Pathways for action* (*Figure 14*). This shows the diversity of available resources, which cover:

- The potential scale for action, such as estimating the scale of taxes, subsidies and payments for ecosystem services through valuation methods (*Data and Methodology* working group),
- The different choices and avenues for future decisions, such as payments for ecosystem services, policies, private sector investment, action on the drivers of adoption, etc. (*Options and Pathways for action* working group),
- The predictions for future situations to adjust the scale and scope for action, such as current biophysical trends, climate change impact, and human pressures, and how to take the most relevant option and pathway for action (*Scenarios* working group).

It is important to note that economic valuation (data and methodology) and the consideration of scenarios provide information for more economically sound decision-making, but options and pathways for action can be adopted independently.

Options and pathways for action: Scaling up and out

The focus on the value of the agricultural sector in the current literature is in accordance with concerns for food security, but fails to consider the economic use values that could be derived from converting land from agriculture use to alternative economic activities, such as tourism and mining. It also ignores the non-use value of land-based services. Collectively, this means that the true economic value of land and land-based services is underestimated. There are two consequences of this: (i) decision-making based on use-value estimates will not reflect values to society as a whole and could generate more losers than winners, and (ii) not measuring the non-use value leads to missed opportunities in setting up new economic activities, which could capture at least some of this non-use value. A more comprehensive approach to the total economic value of land involves combining both use and non-use values, and would show more balance between the different methods used and the different services valued.

Adoption of more sustainable land management (decreasing land degradation) was touted in almost all studies as the most economically sensible future, in line with what was presented in Nkonya et al. 2011 (Ch. 6, pgs. 149–181)[38] and von Braun et al. 2013 (*Figure 15*)[11]. The actual options and pathways suggested and analysed in the studies demonstrated a range of possible actions for implementation of sustainable land and land-based ecosystem service management. Alternative land practices (e.g., afforestation or reforestation, conservation for tourism) were proposed and determined to have positive values even when considering associated costs. Recommended profits can come from numerous sources, including; increased crop and livestock production, increased tourism, increased market prices (for land), and payments for carbon sequestration. Overall, the case studies provide a rather holistic practical path forward, where sustainable land management is tied in with increased economic viability for the greatest social and economic net profit.

Pathways to provide these options rely mostly on the policy-making process and government action, and can provide direct benefits to private stakeholders. These private investors will act if they can be convinced that they will get a return on their investment The provision of funding from external donors or private investors thus ultimately depends on their incentive to do so, which may change over time. Shorter term funding can be effective in promoting change if it lowers financial barriers to change.

TABLE 7

Drivers related to land degradation and their causes
(adapted from von Braun et al. 2013[11], Table 1)

Driver	Proximate	Underlying	Natural	Anthropogenic
Topography	✔		✔	
Land Cover	✔		✔	✔
Climate	✔		✔	
Soil Erodibility	✔		✔	
Pest and Diseases	✔		✔	
Unsustainable Land Management	✔			✔
Infrastructure Development	✔			✔
Population Density		✔		
Market Access		✔		
Land Tenure		✔		
Poverty		✔		
Agricultural Extension Service Access		✔		
Decentralization		✔		
International Policies		✔		
Non-farm Employment		✔		

BOX 8

Pressures and drivers of land degradation for consideration in economic assessment of action

(sourced from von Braun et al. 2013 [11])

When considering something like land degradation that has potentially large-scale temporal and spatial impacts, it is important to be able to identify potential outcomes based on all the different variables at play. Thus far, the main pressures on land that have been considered in the literature include:

Changes in biophysical factors, including climate change [90, 91, 92, 93, 94]

Climate, that is, precipitation and temperature, combined with topography, determine vegetative cover and growth in any region. Alterations in these parameters will affect vegetative ability to adapt, leading to loss of cover, soil erodibility and erosion, soil salinization, poor organic matter production, and increased oxidation, amongst other things.

Impact of pests, diseases, and invasive species [95, 96, 97, 98, 99]

Pests and diseases can lead to loss of biodiversity, crop and livestock productivity, and other forms of land degradation. Invasive species can also lead to a loss of economic benefits associated with tourism when tourists value native species more than invasive ones.

Changes in land use [25, 100, 101, 102, 103]

Land clearing, overgrazing, bush burning, pollution of land and water sources by agriculture or industries, and soil nutrient maiming are amongst the major causes of land degradation. For example, the conversion of grasslands, rangelands, and forests to irrigated farming can result in increased soil salinity and loss of forest services.

Changes in price levels and speculation over agricultural prices [104, 105]

During the period from 1970 – 1985, maize and fertiliser prices influenced forest conversion to planted agricultural areas in Mexico. Beef prices, credit disbursement, and population numbers have also influenced cattle numbers and associated land uses. Relative change in prices can therefore provide strong incentives to change land use, especially for poorer populations.

Changes in income (poverty) level and number of income sources [103, 106, 107, 108, 109, 110, 111]

The poor are often associated with land under high levels of degradation. It is not always clear whether it is poverty that leads to land degradation or land degradation that leads to poverty. On the other hand, the poor's livelihoods often depend heavily on their land and they have therefore a strong incentive to invest into maintaining their land in a good state. As a result of this context-dependent relationship, an increase in income level (decrease in poverty level) could either help achieve more sustainable land management, or further drive land degradation. It would seem that land management is more sustainable for people depending directly on land and less sustainable when livelihoods are less directly derived from land use. Investment and development of alternative livelihoods could help farmers rest their lands or use non-farm income to invest into land improvements.

Increase in population numbers and/or density [7, 112, 113, 114, 115, 116, 117, 118]

Increasing demand on the productivity of the land (without increasing the yield of a singular land unit both long-term and sustainably) by a rapidly growing human population or population density can lead to more rapid and less sustainable extractions that further land degradation. However, bigger populations can also put more pressure on land owners to maintain their land in good condition. Whether population and population density lead to land improvements or land degradation depend on the specific case study context.

Changes in consumption patterns, access to market and level of supply chain development [73, 103, 119, 120]

There is a marked increase in the consumption of meat and "westernised" food staples in rapidly emerging economies. This shift to resource-intensive consumption can result in widespread deforestation, over-grazing, and further resource consumption by livestock. Land degradation can also occur in association with the development of infrastructure as well as new processing and storage facilities, which improve market access. This is because these facilities can lead to increased demand and thereby intensification of production. Improved market access also increases the opportunity cost of labour which in turn increases land degradation when labour-intensive practices are also the most sustainable. On the other hand, land users in areas with good market access have more incentives to invest in good land management.

Changes in land tenure and property right allocation [104, 121, 122, 123, 124, 125, 126, 127]

There is some mixed evidence showing that well-defined and secure land tenure can help achieve more sustainable land management. Insecure land tenure has been shown to be associated with adoption of less sustainable land management practices. However, this is not always the case, as farmers may still invest in sustainable land management despite insecure property rights. The problem of property right security and allocation is therefore not relevant when land is already managed sustainably, but is relevant when land is managed unsustainably. When land is managed unsustainably, there is almost always potential to improve land management by making property rights more secure or better allocating them.

Changes in foreign direct investment [159]

Multi-national enterprises and nations now commonly invest directly in foreign lands to meet their own resource needs, or to capitalise on resources found elsewhere. However, they do not necessarily have an incentive to maintain the land quality over time, as they can always choose to invest somewhere else. A lack of policy within host countries (often developing nations) can lead to over-exploitation and unsustainable practices that directly affect the land people traditionally use for self-sustenance and income.

Changes in institutional settings [110, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143]

Access to agricultural extension services has the potential to enhance the adoption of more sustainable land management, depending on the capacity and orientation of the extension providers. Setting up cooperative systems can also improve land management by fostering knowledge exchange and bulk buying. Increasing school age and providing training specific to land management may also increase land management sustainability. Sustainable land management can also be enhanced through decentralisation, allowing local institutions to set up land registration systems to effectively secure property rights. Also, strong local institutions with a capacity for land management are likely to enact bylaws and other regulations.

Changes in domestic and international policy [125, 144, 145, 146, 147, 148, 149, 150]

Domestic policies that will impact land management are extremely varied and go beyond the agricultural sector and land tenure. Policies that can foster adoption of sustainable land management are, for instance: stable agricultural pricing policies, policies increasing returns to sustainable land management enough, labour policies that balance "pulling" workers to the manufacturing sector and "pushing" them out of agriculture with food production needs, policies that helped provide access of poorer rural households to land and credit markets, to the necessary key infrastructure, provided support private sector initiatives, provided effective rural extension service and marketing services to the poor in rural areas, successfully reduced corruption. The removal of perverse subsidy programmes can also be just as effective as implementing new policies. These policies are usually not enough to promote sustainable land management on their own, thus requiring a coherent series of policy measures to be adopted. This also requires the adoption of relevant macro-economic policies for international trade, and the assessment of trade-offs with other sectors of the economy. For instance, building a dam will help improve the country's energy production and control of water flows, but also means the loss of agricultural land in the areas that are flooded.

International policies through the United Nations and other organisations have influenced international and national policy formulation and land management. The World Trade Organization offers a platform for exchange and negotiation to remove policies that are detrimental to trade (i.e., western subsidy schemes for farmers that distort world prices and are detrimental to poorer countries).

TABLE 8

Potential scenarios, from most ideal (darker green) to least (darker brown)
(adapted from the UK National Ecosystem Assessment 2011 [27])

Conservation Fully Implemented	This amounts to protecting the ecological environment. Ecosystem services are promoted for maximal environmental health. There would be a decline in income derived from intensive agriculture, and changes to the market. However, this would see the largest net social benefits, increases in long-term sustainability, green space, social and recreational values, and declines in greenhouse gas emissions and loss of viable land.
Green and Pleasant Land	A moderate reduction in agricultural intensity will lead to a decline in farm income. The focus is pro-environmental and will result in greenhouse gas reductions, and increases in green space, recreational, and social values. However, it can greatly impact a nation's overseas ecological footprint, if they are unable to meet their own food needs. This should be done respecting cultural values.
Local Stewardship	Society is concerned with their immediate, local surroundings, and strives to make sustainable life a focus in this area. There is not much focus on intervention or assistance to other nations, or concern about an overseas ecological footprint. This is a small scale win-win, but not a global one.
Maintain Current Practices	The status quo is maintained. At best, market prices, agricultural incomes, and recreational values will increase, but be negated by an increase in greenhouse gases and continued loss of viable land. In developing nations with drylands, living conditions will decline as viable land becomes scarce and degraded.
National Security	Climate change will result in increased global energy prices, and force many countries to focus on self-sufficiency. Market prices and agricultural income may increase, but there will be continued decline in land availability and greenspace that will dominate the other monetary values generated, resulting in an overall negative value. Governance and intervention will dominate.
Focus on Market Growth	In this scenario, a focus on the highest economic growth possible will drive land management decisions. With only a focus on market value for goods, this will trigger increases in greenhouse gases and a steady loss of viable land. This situation is expected to result in the most substantial reduction in the net social values of any of the scenarios.

Scenarios: Looking forward

The main pressures on and drivers of land use change that have been considered in the literature include: climate change, population increase, changes in consumption patterns, and changes in foreign direct investment. In combination with increasing land degradation and desertification, several scenarios can be constructed based on these identified pressures (*Box 8*, *Table 7*, and *Table 8*).

It is further possible to construct a matrix of potential scenarios involving a series of variables (climate change, market growth, social values, etc.), and chart the likely outcomes of different balances in choice. This has already been done in various contexts, including an in-depth analysis performed for the United Kingdom by the UK National Ecosystem Assessment in 2011 [27]. *Table 8* is an adaption of their research on future scenarios, but with a more targeted focus on land use management and choices.

What are the opportunities for the private sector?

These case studies reveal that there are not only economic benefits from sustainable land management, but also new opportunities for the business sector to invest in and contribute to beneficial social and environmental impacts through better production and livelihood strategies. Studies have demonstrated that addressing land degradation, mitigating the negative impacts caused by industry, and/or improving raw material availability by ensuring sustainable land management, can result in business opportunities[151].

Businesses can also gain through involvement in partnerships with other private and civil society sectors. For example, Coca-Cola India partnered up with an irrigation company (Jain Irrigation) to improve mango production and reduce soil erosion. By investing EUR 0.75 million each, mango production was doubled, and around 50,000 farmers were educated in better land management practices. Farmers invested around EUR 1,050 per acre in better cultivation and irrigation systems, and since 2011, some 60 % of the mango pulp needed by Coca-Cola India has been sourced within the region targeted by the project[151].

In an analysis of risks from land degradation to the private sector (commissioned by the ELD Initiative), the highest at-risk sectors were: basic resources (forestry, papers and metals), food and beverages, construction materials, leisure and travel, water and electricity utilities, and personal, household, and industrial goods[151]. This study shows the benefits from sustainable land management extend beyond the agricultural sector. In particular those businesses that had direct contact with land, food and beverage, leisure and travel, and basic resources were most sensitive to land degradation. They are also likely to be the most interested in efforts to prevent and/or reverse land degradation.

BOX 9

Knowledge gaps

Technological

1. Overall costs/benefits of different land management interventions (trade-offs with focus on livestock and rangelands)
2. Understanding of drivers of changes (case studies)
3. Relationship between population density and land degradation
4. Identify system tipping points for land degradation

Environmental evaluation

5. Lack of harmonised methodology (scales, discount rate)
6. Lack of information on social costs of land degradation
7. Lack of information on mapping ecosystem services
8. Lack of information on non-market values of ecosystem services
9. Lack of robust low cost methods applicable by affected countries in short term
10. Limited understanding of value of ecosystem services to local livelihoods

Policy

11. Lack of plausible scenarios
12. Lack of monitoring and evaluation for total ecosystem assessments
13. How can policies promote sustainable land management

Institutional and private sector

14. Lack of incentives for sustainable land management
15. Greater interdisciplinary approaches (incentives)
16. Lack of knowledge management

Going beyond knowledge gaps: Case studies commissioned by the ELD Initiative and links with parallel initiatives and projects

The ELD Initiative aims to build from and move beyond the initial case studies undertaken by ZEF and IFPRI[38] by estimating the total economic value of land, and better reflecting the true worth of land to society as a whole. The initiative also aims to move beyond the sole consideration of agricultural production (foods and raw materials) and include other land-based economic activities for improved identification of the most economically viable and desirable type of action.

Contrary to current perceptions, the range of case studies collected so far shows that valuation approaches do not have to be necessarily complex and complicated[83,152,153,154,155,156].

The ELD Initiative is addressing the issue of land degradation and economic valuation through several key projects. With funding support from its partners, new case studies focused on these issues are in the process of being funded by the ELD Initiative. Research projects were selected based on scientific merit and the ability of the project to address identified knowledge gaps (*Box 9*).

Out of 64 proposals received, 3 research proposals were competitively selected for funding by the ELD Initiative to address some of the gaps identified. They were chosen based both on a series of criteria listed in the call for proposals, and to ensure a comprehensive geographical and thematic scope.

The first proposal is from the University of Wyoming, with an objective to provide a more systematic spatial and econometric analysis of the concentration of the world's rural population and poor on degraded and less favoured land. It includes implications of this concentration for the incidence of poverty across low and middle income economies, and suggests improved policies for sustainable land management.

The second proposal is between the University of Leeds (Sustainability Research Institute), Birmingham City University, and the University of Botswana. It seeks to advance knowledge on the costs, benefits, and trade-offs associated with land use and management strategies in southern Africa, including: private ranches, communal grazing, parks, and wildlife management areas, with a focus on capacity building and interdisciplinary methodological development.

The third proposal is between the International Union for the Conservation of Nature and project partners in Mali, Jordan, and Sudan. It is an economic valuation of rangeland ecosystem services and degradation, and a cost-benefit analysis of sustainable land management methodologies. It will identify management options, relevant ecosystem goods/services to be valued, and policy and investment pathways and recommendations.

Through collaborative funding focused on the key areas of land degradation and environmental economics, the ELD Initiative aims to provide on-the-ground research that reaches all levels of stakeholders and results in efficient, tangible changes towards sustainable land management. Having useful and practical examples can provide guidance to decision-makers, private industries, various levels of governments, and any practitioner, in a global effort to achieve economically viable, improved land management. Joining forces with complementary initiatives and projects promotes the cohesive, multidisciplinary, multi-tiered approach that is needed to effectively trigger action in tackling this complex global issue.

The collection of knowledge and research assembled by the initiative demonstrates that it is possible to arrive at a basic starting point for valuation in any situation, and then make the estimation of the economic value of land more complex and relevant over time. The ELD Initiative aims to make these methods simpler to understand and apply by providing and establishing a series of likely scenarios, identifying potential options and pathways for relevant action, and then providing a practical, useful toolbox for valuation.

Selected case studies

CASE STUDY 9

The contribution of forest products to dryland household economies: Kenya

(Ngugi et al. 2011 [154])

Summary

An ethnobotanical survey was undertaken in the Kiang'ombe forests found in the Mbeere District of Kenya, using an amalgamated method of participatory rural appraisal (PRA), participatory environmental valuation (PEV), household surveys, group discussions, and forest walks with informed locals. The use of PEV in this region, where no formal forest use records exist, was important when assigning monetary value to elements of biodiversity essential to survival, but presumed to be "free for the taking". Assigning monetary values gives credence to non-monetary values that are recognised by locals, but otherwise ignored as they do not enter "formal markets". PEV is a recommended method when estimating the value of forest resources in a non-monetary environment ("non-cash economy").

The average annual forest value to a household was found to be KSh. 16,175.6 (USD 256.80), approximately 55.4% of the average household income. There were ten forest uses found, with the service most depended upon being the supply of building materials and medicine. Medicine had the highest average annual household value, at KSh 2953 (USD 47).

Context

Kiang'ombe hill forest is under Trust Land tenure, and as such exposed to over exploitation, with unequal access to products and benefits by the adjacent communities because of poor management and lack of control by the local county council. The forest is surrounded by an increasing population which is encroaching on it with heightened pressure. As a result, there are anthropogenic disturbances such as subsistence cultivation, charcoal production, and frequent forest fires which are set annually in preparation for the rains.

There is a need for better management planning, but it can only be effective if the needs of the local community are respected. This can be achieved either by maintaining current uses, or providing alternatives. Any action requires determining which forest services and products have the most value to the local community. This study thus aimed to estimate the value of the forest to the local community by valuing plant products extracted from it and activities held within it, both of which contribute to the household economy.

Method overview

This study uses PEV; a form of contingent valuation where people state how much they value a good or service using an item of value that can easily be translated into a monetary amount. This was particularly appropriate to the study context because of the lack of formal forest-use records, and the fact that some of the surveyed activities are officially banned.

Thirteen villages across three locations around Kiang'ombe Hill were selected. Participants were asked to identify and rank forest uses along the importance they had to them, and then assign a number of counters to reflect these values to them. Participants were also requested to identify the priced good associated with the counters, its average lifespan, and its market price. The household survey questionnaire used is published as an annex of the paper.

In addition, a household wealth ranking was undertaken during group discussions with village elders to check for differences in forest use across different wealth groups. This wealth ranking assessment relied on livelihood analysis and household survey for plant usage and annual family earnings. Data gathered during direct interviews was used to estimate average household resources.

Results

Participants chose the value of a bicycle in the local economy (KSh 3000, ~USD 47.6), with a discount rate of 3% and lifespan of 5 years, to measure the value they attach to each forest use. The main value of the forest to participants was associated with medicinal products (6–9% of annual household income), then fuel wood, building material, bee farming, veterinary medicine, food, timber, fibre, weaponry, stimulants, and thatch. There were a few variations across wealth groups, but the overall tendency remains the same.

Valuation results are represented for each wealth group, but do not show any change in the level of dependence on the forest based on wealth status.

Issues (theory and practice)
Participatory environmental valuation technique allows villagers to express the value of forest products within the context of their own perception, needs, and priorities rather than through conventional cash-based techniques. Its strength is that it relies on local knowledge.

However, wealth ranking was found to be a flawed technique, because of personal relationships between people assisting with the ranking and the interviewees. The most accurate method was found to be accompanying resource users into their fields to observe the parts of plants gathered and gauge the volume of harvest. This method can be time consuming however, and becomes increasingly challenging when there is an increase in participants involved.

Participants were not willing to value the use of the forest for rituals and cultural ceremonies. They stated was that it was the realm of the community sages and therefore the value of such services was above their wisdom.

Conclusions and recommendations
Dependency upon the forest by locals cannot be ignored if forest management plans are to be successful. Understanding forest income-dependence is important in guiding plans for forest product use at all levels of governance. It is also very important to find win-win solutions, such as conservation strategies that involve local people and provide for sustainable livelihoods. For instance, local communities could cultivate more of the useful trees for household use and sale, whilst forest management activities could be developed to support indigenous tree planting for reforestation. In addition, governments could help build partnerships with local communities and NGO's, so as to reduce population pressure on the forest. This could be done by focusing on improved health and nutrition for improved family planning as well as improved education of local populations for forest conservation.

The original publication includes a figure showing wealth levels and forest resource dependence per household near Kiang'ombe hill forest. This figure could be used to inform prioritizing action over current forest uses. The most important use of the forest is for medicinal purposes – therefore, action could be taken to ensure sustainability of this use, or to provide suitable alternatives that would be acceptable to and preferred by the local community.

CASE STUDY 10

The value of land resources in the Cardamom Mountains in Cambodia: South East Asia

(Soussan & Sam 2011 [156])

Objective of the study
Ecosystems in the Mekong region contain biodiversity resources of global significance and provide services to both locals and non-locals. This study attempted to value all ecosystem services provided by a smaller area of the Mekong region, the Central Cardamom Mountains in Cambodia. This area contains globally threatened species and high levels of endemism, and its services include: carbon sequestration, non-timber forest products, and watershed protection functions. This study identified the role and value of land resources to livelihoods of local communities, and aimed to generate evidence to support sustainable land management policies and investments, based on existing and potential contributions to national development and poverty reduction.

Method overview (including aggregation method)
This study used the 6-step methodology (detailed in Chapter 2) to assess the value of sustainable land management and the cost of land degradation. It also informed potential action by identifying sustainable land management policies and options that would contribute to the maintenance of ecosystem integrity and land resource values of the Cardamom Mountains and comparable areas in Cambodia. This study involved assessing the distribution and inherent quality of land resources, analysing the role of these resources in the livelihoods of local communities and wider ecosystems service functions, and assessing the main degradation pressures on these resources.

Economic valuation of **timber** (provisioning service) was based on the benefit transfer approach from recent studies in the same region. Two alternatives were taken for valuation: the value of the stock of timber available if forests were clear-felled, and the value of the timber services provided by the forest through sustainable harvesting and thus for a longer period of time.

Economic valuation of **agricultural lands** (provisioning service) was based on two methods of estimation: the first one was the market price of rice (border export price for South East Asia) multiplied by the quantity of rice produced to estimate the overall value of rice production in the area; and the second estimated the value of rice production as a proportion of household income. Non-marketed crop values were not estimated in this study.

Economic valuation of **watershed functions** (regulating service) was based on a benefit transfer approach, from a recent study of the value of watershed functions in relation to hydropower in Vietnam.

Economic valuation of **biodiversity** (regulating service) was based on a benefit transfer approach, derived from a study on the value of biodiversity for high quality forests. The value was updated based on inflation and increased biodiversity pressures, as well as on international comparisons. Appropriate values were also estimated for other land cover types (with an unspecified valuation method).

Economic valuation of **carbon sequestration** (regulating service) was based on the value of the carbon stored by the forest in the study area, and estimated using the market price and quantity of carbon stored by tropical forests from REDD-related studies in the Mekong region.

Economic valuation of **tourism and other cultural (spiritual) services** (cultural service) was not specifically assigned in this study. Biodiversity richness and the beauty of the landscape make the central Cardamom Mountains an area of great (eco-)tourism potential (high value niche market). However, the lack of facilities and poor transportation means that tourism is small scale and confined to limited parts of the region that are close to main access points. The extent and value of potential tourism is a matter of speculation, and will depend on the level of investments made in transport, accommodation, and other facilities. Cultural (spiritual) values are of great significance, but difficult to quantify in monetary terms, and so this study did not estimate them.

Contextual pressures

Livelihoods of the communities in and around the study area are completely dependent upon access to land resources. The main sources of livelihoods are derived from a combination of farming (rice), livestock rearing (with fodder collected from or grazing in the forests) and the collection of fuel, foods, and other forest products. There are also a small number of traders and shopkeepers who service the rest of the population, and a few people employed by the government or other outside agencies as rangers or similar positions. They do not depend directly on the land resources for their livelihoods, but rather indirectly through their customers or because of the nature of their jobs.

This study has identified a "livelihood support zone" surrounding each village, as the forest and land resources of these zones underpin the villagers' livelihoods. Access to these resources is essential for basic survival.

There are concerns over the extent and severity of land resource degradation in this area due to soil erosion and deforestation. Traditional and sustainable systems of land resource management are increasingly under pressure following recent influxes of migrants to the area, which has led to new forms of land resource exploitation and encroachment as well as increased use pressures. Pressure on land resources have also increased because of illegal forest exploitation (e.g., illegal logging or wildlife trade), and are threatening the ecological integrity of vulnerable ecosystems.

Economic valuation results

Economic value of **timber** (provisioning service): total stock values were estimated as high as USD 20,000/ha if forests were clear-felled, and the total timber service value with sustainable harvesting ranged from USD 200–450/ha/year, depending on forest type and quality. If the entire area was sustainably harvested, this would have an aggregate income of **nearly USD 440 million annually**.

Economic value of **agricultural lands** (provisioning service): the average rice production is 758 kg per household per year, which is lower than subsistence needs. The border price for South-East Asia available from FAO at the time of the study was USD 460/ton, making rice production worth USD 349 per household per year. This provides a total of just under USD 1,400,000 per year for the whole study area. A second method of estimation gave the same estimates: rice production amounts to 66 % of household income, representing about USD 363 per household per year and a total of just over USD 1,450,000 per year for the whole study area. The total economic value of the 6,682 ha of agricultural lands in the study area is thus estimated to amount to **USD 1,500,000 per year**.

Economic value of **watershed functions** (regulating service): estimated annual benefits to hydropower schemes from erosion protection were USD 55/ha/year, and from water conservation were USD 15/ha/year. Thus, the value of watershed functions of the study area are **over USD 75 million a year**.

Economic value of **biodiversity** (regulating service): biodiversity value was estimated at USD 650/ha/year for the richest forests, and USD 550 for the remaining forest areas, amounting to an estimate of **USD 1.36 billion per year** for the study area.

Economic value of **carbon sequestration** (regulating service): sequestration was estimated at **USD 3,669 million**, one of the highest value for an ecosystem service in the region. This is a globally significant resource.

Economic value of **tourism and other cultural values** (cultural service): there was no available value estimate, but they are suspected to be economically significant.

Issues (theoretical and practical)

An issue in this study was the lack of data in the area of estimating potential economic benefits from tourism in the Mekong region. Additionally, some of the values estimated reflect potential benefits (e.g., carbon storage) rather than actual benefits, and may not be realised fully.

Conditions for successful action

All of the values cannot be realised at the same time (e.g., clear-felling trees and storing carbon), so choices will have to be made amongst the options. Furthermore, it should be clear who would pay for each of these services and how. For there to be successful management of service-providing resources, there must be effective, legitimate, and understood governance in sustainable land management, as well as access to the benefits of ecosystem services.

Conclusions and recommendations

The land resources of the Cardamom Mountains have multiple values, many of which have traditionally not been taken into account in planning decisions. These resources underpin local livelihoods and are of national and global significance. There are several options to develop sustainable land management strategies that reflect local dynamics of change and can provide a more harmonious relationship between desirable development (e.g., livelihood changes, hydropower investments) and long-term sustainability of land resources.

The livelihood of local communities depends on sustainable access to a variety of resources gathered from local forests and lands, in addition to farming. Most of the resource uses are based on a customary rights system rather than land ownership, and come from a zone within five kilometres of villages. This zone could be placed under a form of communal management, with safeguards for sustainable management. Local communities have shown great interest in being involved in the management of the resources they depend upon.

Hydropower schemes currently being developed in the area will bring great benefits to Cambodia's overall development. In turn, they would gain enormous economic benefits from effective watershed conservation that conserves water and reduces sedimentation. A payment for ecosystem service could be implemented, with income for this scheme levied based on electricity consumption.

The forest conservation measures already in place in the Cardamom Mountains should be continued and strengthened, so as to maintain the high value biodiversity, watershed maintenance, and carbon sequestration ecosystems services that are contingent upon continued integrity of its large forest ecosystems. A payment for ecosystem service could be implemented, with income for this scheme levied from tourists and downstream water users.

There is also a need to better regulate and limit the impact on resources from 'outsiders' who illegally occupy land newly made accessible by road transport improvements. This could be achieved through working with existing and new migrants to assist them in developing sustainable systems of land management compatible with the actions taken by local communities. These systems could include the development of appropriate and sustainable upland farming systems on permanent plots closer to the villages, which would also help reduce "slash-and-burn" farming.

Preliminary analyses of case studies: A summary

This non-exhaustive review of sound, global research has demonstrated many important ideas that will be integral to the foundation of the ELD framework. The groundwork for this can be found in Appendix 3, which includes the 87 case studies in the ELD database that have provided monetary values for land and land-based services. The appendix provides further particulars on geography, valuation method, valuations, etc., that were discussed in Chapter 3. As demonstrated in these details, the current focus on economic valuation as it relates to land has been primarily within the last 5 years, targeted at developing nations by researchers in developed nations, and has focused on use and agricultural values. Within the scope of the current research available in this database, knowledge gaps were identified that could easily be addressed, and that will provide great progress in tackling the issue of land degradation from an economic perspective.

Overall, parties involved on all levels should strive to create a relatively balanced focus between the means (valuations and scenarios) and the end (options and pathways for action). This can be achieved through a focus on capacity development in developing nations (which often contain the most degraded lands) that is locally targeted and applicable, with valuations that analyse the full economic value of land, and the development of tools created at appropriate scales that will ensure maximal uptake of economically sound and sustainable land management practices for the most optimal benefits for society as a whole.

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Appendix

Appendix 1 – Economic valuation methods

(Adapted from Adhikari & Nadella 2011, pgs. 138 – 139 [157]*; Nkonya et al. 2011, pg. 72* [25]*; Requier-Desjardins, et al. 2011, pgs. 287 – 289* [158]*)*

Method	Description	Steps in implementing the method	Type of economic value captured	Example	Data and methods: Advantages	Data and methods: Limitations
Non demand-based						
Market price	Gives an estimate of the total economic value (people's actual willingness to pay) in theory, often of the direct use value in practice	▪ Costs to buy or sell a good or product ▪ Collect market data on prices ▪ Estimate quantity consumed/sold ▪ Multiply price by quantity	Total economic value in theory (in practice, use value)	Crop prices	**Method:** direct estimation of value, associated to actual money flows **Data:** market prices can be recorded easily	**Method:** missing or distorted markets **Data:** market prices can be missing or inaccurately recorded
Replacement costs	Estimates the costs of replacing ecosystem services and goods	▪ Ascertain benefits associated with good/service ▪ Identify most likely alternative to provide equivalent level of benefits ▪ Calculate costs of installing and running replacement	Use value	Costs of fertilisers to replenish soil nutrients	**Method:** easy to implement **Data:** market prices of replacements can be recorded easily	**Method:** the assumption that the artificial replacement is equivalent may not be true and the replacement cost may only reflect part of the total economic value. **Data:** replacement costs can be incomplete or inaccurately recorded

Method	Description	Steps in implementing the method	Type of economic value captured	Example	Data and methods: Advantages	Data and methods: Limitations
Dose-response	Estimates by how much price or quantity change for a change in production inputs quantity. Also called production function–based or productivity change approaches.	▪ Determine contribution of good/service to related source of production ▪ Specify relationship between changes in good/service and changes in related output ▪ Relate change in provision of good/service to physical change in output ▪ Estimate market value of change in production	Use value	Estimation of changes in crop yields (causing losses in agricultural profits) for a change in fertiliser quantity.	**Method:** easy to implement in a production setting, with clear inputs and outputs relationships	**Method:** the relationship between change in ecosystem services (dose) and production (response) is not always easy to model or estimate, and may not be applicable in different settings
					Data: based on biophysical data with records often available in a production setting	**Data:** fairly data intensive to build a model
Damage cost avoided	Estimates the use value of the avoided costs of land degradation	▪ Identify protective functions of good/service ▪ Identify damages caused by loss of different degrees of protection ▪ Locate infrastructure, output, or population that would be affected ▪ Obtain information on likelihood and frequency of damage occurring ▪ Cost damages associated with given loss of good/service	Use value (indirect)	Benefits from reduced (avoided) silting of watercourses, reduced (avoided) coastal erosion	**Method:** easy to implement	**Method:** prone to overestimation. Avoided damage costs may not be equal to economic benefits. It is not always easy to estimate because it has been avoided (hypothetical situation)
					Data: based on a mix of biophysical and economic data	**Data:** avoided damage costs can be difficult to measure (hypothetical situation)

Method	Description	Steps in implementing the method	Type of economic value captured	Example	Data and methods: Advantages	Data and methods: Limitations
Mitigation costs	Estimates the use value as the costs of mitigating or averting the loss of ecosystem good or service	- Identify hazards arising from loss of good/service - Locate area and population that would be affected - Obtain information on peoples responses and measures taken to cope with effects of loss - Cost the mitigation response	Use value (indirect)	Costs of maintaining hedges or dry stone walls to reduce soil erosion	**Method:** easy to implement **Data:** easy to measure	**Method:** prone to overestimation **Data:** mitigation costs can be incomplete or inaccurately recorded
Opportunity costs	Estimates use value as the profit made under the next best alternative land use	- Identify the next best alternative land-use - Estimate costs and benefits of this next best alternative - Calculate the forgone profit from this next best alternative as the measure of opportunity costs	Use value	The opportunity cost of a forest stand is the profit from agricultural production that could be made by converting forested land to agriculture. This opportunity cost is usually lower than the economic value of current land use (forest), or the land would already be converted to agriculture	**Method:** allows to consider alternative land uses considering that the current one is the most economically profitable **Data:** easy to measure for existing nearby alternative land uses	**Method:** second-best alternative under-estimates the benefits from the current (first-best) one **Data:** alternative land use costs and benefits can be difficult to transfer to a given context (hypothetical situation)

Method	Description	Steps in implementing the method	Type of economic value captured	Example	Data and methods: Advantages	Data and methods: Limitations
Demand-based methods: Revealed preference (use value)						
Hedonic price method	Estimates use value as a proportion of surrogate market prices	▪ Find a surrogate market where the value of the good or service to be valued is embedded into ▪ Identify characteristics that influence the surrogate good market price ▪ Decompose the price of the surrogate market good into individual characteristic prices ▪ Estimate the demand curve and compute the willingness to pay. Alternatively, take the unit price for the good or service to be valued.	Use value	Value of a nearby park or sea view captured in house prices to determine entry fee or tax level	**Method:** relies on an existing surrogate market **Data:** can be easy to obtain	**Method:** the surrogate market may be distorted or imperfectly recorded, and may imperfectly capture the use value of the good or service to value **Data:** may be incom-plete or inaccurately recorded
Travel cost method	Uses travel costs to estimate use value	▪ Identify area from which visitors come, how much time and money they spent to get to the area to be valued, and their socio-economic characteristics ▪ Estimate the cost of one trip as a function of the number of visitors, travel costs, travel time, and visitors socio-economic characteristics ▪ Introduce a hypothetical entry fee and calculate the expected number of visitors from the new total cost (demand curve) ▪ Calculate consumer surplus from this demand curve	Use value	Value of a national park inferred from observed travel costs to set an entry fee	**Method:** can be easily implemented through a survey of visitors at a given geographical spot **Data:** easy to collect through survey of visitors	**Method:** limited to recreational benefits linked to a trip **Data:** dedicated database which is specific to a given site and time of survey

Method	Description	Steps in implementing the method	Type of economic value captured	Example	Data and methods: Advantages	Data and methods: Limitations
Demand-based methods: Stated preference (Total Economic Value)						
Contingent valuation	Estimates the economic value from stated amount people are willing to pay (or accept)	Survey of respondents: ▪ Present a hypothetical situation describing the environmental good or service, the institutional context, and payment means (tax, fee) in a credible way ▪ Ask respondents their willingness to pay (accept) for an increase (loss) in good or service ▪ Draw up a frequency distribution relating willingness to pay (accept) statements to number of people making them ▪ Cross tabulate willingness to pay (accept) responses with explanatory variables (income, age, education) ▪ Carry out multivariate analysis to correlate responses to explanatory variables ▪ Sum up sample results	Total economic value	Stated value of a nearby park, biodiversity hotspot, symbolic species (blue whale, tigers, mountain gorillas, pandas)	**Method:** easy to understand and implement **Data:** easy to collect through survey or focus groups	**Method:** is prone to many biases, often leads to overestimating the actual willingness to pay, and does not allow to estimate trade-offs between different goods or services **Data:** dedicated database which is specific to a given site and time of survey

Method	Description	Steps in implementing the method	Type of economic value captured	Example	Data and methods: Advantages	Data and methods: Limitations
Choice experiment	Estimate the economic value from stated willingness to pay (or willingness to accept) for a range of attributes (liked to the same or other economic activities) and the trade-offs between them.	Survey of respondents: - Present a hypothetical situation describing the environmental good or service, the institutional context and payment means (tax, fee) in a credible way - Establish alternative options, each of which are defined by various attributes and a price - Design unique choice cards by selecting combinations of alternative options. The respondent should choose only one option from each choice card - Aggregate results and estimate willingness to pay overall and for each attribute	Total economic value	Trade-offs between conservation measures such as the preservation of emblematic species, a biodiversity hotspot or a nearby park, and other economic activities such as agricultural production or mining	**Method:** only method that allows for the estimation of both total economic value, and trade-offs between goods and services **Data:** complete dataset	**Method:** potential biases; context specific **Data:** very data intensive
Benefit transfer						
Benefit transfer	Results obtained in a specific context are transferred to another comparable site	- Identify "source" site(s), that is, the site(s) from which the economic value will be transferred from, and their characteristics (income levels, type of land use, area covered, type of area: hot spot or other, geography) - Estimate the willingness to pay as a function of the source site(s) characteristics - Use the characteristics of the site to be valued in the willingness to pay equation obtained and derive the willingness to pay	Depends on the method used in the original context, before transfer	The value of a biodiversity hotspot is estimated from values of several other biodiversity hotspots and adjusting for specific characteristics (size, income level of stakeholders, etc.).	**Method:** easy to conceptualise and implement **Data:** based on data available in previous studies and does not require primary data collection	**Method:** can be very data intensive. Results can be inaccurate depending on how different social preferences in different places are, and economies of scale and scope. **Data:** previous study results can be biased

Appendix 2 – Required data for drivers of land degradation and their availability (global level analysis)

(from Nkonya et al. 2013[26], Table 5)

Data	Data source	Website	Availability	Accessed
NDVI	GIMMS	http://glcf.umd.edu/data/gimms	Free	Yes
Global Administrative Borders	GADM	www.gadm.org	Free	Yes
Global Soil Properties	ISRIC-WISE	www.isric.org/data/data-download	Free	Yes
	FAO/IIASA	www.fao.org/nr/land/soils/harmonized-world-soil-database/ soil-quality-for-crop-production/en		
Africa Soil Information – Georeferenced Data on Land Degradation Surveillance	AFSIS	www.africasoils.net	Free	No
Biodiversity	PBL	Netherlands Environmental Assessment Agency	Free	No
Climate Conditions	East Anglia Climate Research Unit	www.cru.uea.ac.uk	Free	Yes
Land Management Practices	FAO (Rate of fertiliser use, conservation agriculture, etc.)	FAOSTAT; AQUASTAT	Free	Yes
Topography	YCEO (Yale Centre for Earth Observation) DEM from FAO	www.yale.edu/ceo/Documentation/dem.html	Free	Yes
	CCIAR-corrected SRTM	www.cgiar-csi.org/data/srtm-90m-digital-elevation-database-v4-1	Free	Yes
Road Density		Africa road data – http://infrastructureafrica.org/models/irrigation.asp	Free	Yes
Access to Information	Mobile phone coverage	ITU	Free	Yes

Data	Data source	Website	Availability	Accessed
Land Tenure	WRI, University of Wisconsin	www.wri.org/map/status-land-tenure-and-property-rights-2005	Free	Yes
National Policies	Environmental Performance Index	http://epi.yale.edu	Free	Yes
Institutions	Government effectiveness	www.govindicators.org	Free	Yes
Socio-economic Indicators	World Development Indicators	www.worldbank.org	Free	Yes
Population Density	CIESIN	http://sedac.ciesin.columbia.edu/data/collection/gpw-v3	Free	Yes

Appendix 3 – Case studies

(A repository of references in relation to the approach used for the Economics of Land Degradation Initiative as well as case studies is accessible at www.Refworks.com (Group Code: *RWMcMasterU*, Login: *unu-inweh*, Password: *inweh*).

Case study	Source	Study period	Location of case study	UN world region	Ecosystem services	Valuation methodology	Estimated costs, currency, year of currency estimate
1	King, D.A. and Sinden, J.A., 1988. Influence of soil conservation on farm land values. Land Economics. 64(3): 242–255.	1988	Australia (Manilla Shire, New South Wales)	Oceania	foods	use value only; hedonic price method	Costs paid through property prices for conserving the land range from AUD 0/ha to AUD 11/ha, and the cost of treatment (i.e., adopting practices reducing land erosion) is AUD 1/ha
2	Nelson, R.A., Dimes, J.P., Silburn, D.M., Paningbatan, E.P. and Cramb, R.A., 1988. Erosion/productivity modelling of maize farming in the Philippine uplands: Part III: economic analysis of alternative farming methods. Agricultural Systems. 58(2): 165–183.	1997	Philippines (uplands)	Asia	foods	use value only; dose-response method; market price method	Net present value ranging from PHP -2,000/ha/yr to PHP 40,000/ha/yr (10% discount rate)
3	Bishop, J. and Allen, J., 1989. The on-site cost of soil erosion in Mali. Environment Working Paper No. 21. The World Bank, Washington D.C.	1989, based on data from 1981–1988	Mali (using data from Burkina Faso)	Africa	foods; fibres	use value only; dose-response method; market price method	Average loss of N, K, P on cropland ranging from USD 0.79/ha (CFA 236/ha) to USD 5.46/ha (CFA 1,638/ha); nationwide of USD 7.41 million (CFA 2,225 million), i.e., 0.37% GDP of Mali and 0.95% of agricultural GDP
4	Rockel, M.L and Kealy, M.J. 1991. The value of nonconsumptive wildlife recreation in the United States. Land Economics. 67(4): 422–434.	based on data from 1980	United States	Americas	recreation (non-consumptive use of wildlife)	use value only; benefit transfer; other valuation method (time spent wildlife watching)	Aggregated welfare estimates from participation range from USD 7.8–161 billion, depending on the value allocated to time and functional form used

Case study	Source	Study period	Location of case study	UN world region	Ecosystem services	Valuation methodology	Estimated costs, currency, year of currency estimate
5	Garrod, G.D. and Willis, K.G. 1994. Valuing biodiversity and conservation at a local level. Biodiversity and Conservation. 3: 555–565.	1994	Great Britain	Europe	recreation; amenity; other cultural services	Total Economic Value (TEV); contingent valuation	Total average WTP: GBP 10.045/yr/member of the wildlife trust. The CVM responses suggested that members would be willing to pay an aggregate of GBP 2,404/yr towards the conservation of Border mires; GBP 9,444/yr for the conservation of the red squirrel in Kielder Forest; but only GBP 1,492/yr towards the provision of new Trust headquarters
6	Navrud, S. and Mungatana, E.D. Environmental valuation in developing countries: The recreational value of wildlife viewing. Ecological Economics. 11: 135–151.	based on data from 1991	Kenya (Lake Nakura National Park)	Africa	recreation	use value only; travel cost method; contin-gent valuation	Annual recreational value of wildlife viewing in Lake Nakuru National Park in Kenya was found to be USD 7.5–15 million.
7	Pimentel, D., Harvey, C., Resosudarmo, P., Sinclair, K., Kurz, D., McNair, M., Crist, S., Shpritz, L., Fitton, L., Saffouri, R. and Blair, R., 1995. Environmental and economic costs of soil erosion and conservation benefits. Science. 267(5201): 1117–1123.	1994	Global	World	foods; pastoralism/meat; water flow regulation; soil regulation; recreation	use value only; replacement cost method; dose-response method; opportunity costs	Investment of USD 6.4 billion/yr (40/ha/yr for conservation) to reduce US erosion rates from about 17 tons/ha/yr to a sustainable rate of 1 ton/ha/yr on most cropland, and an additional USD 2.0 billion/yr (USD 5/ha/yr for conservation) to reduce erosion on pasture-land. Erosion causes about USD 44 billion/yr in damages

Case study	Source	Study period	Location of case study	UN world region	Ecosystem services	Valuation methodology	Estimated costs, currency, year of currency estimate
8	Barnes, J. 1996. Changes in the economic use value of elephant in Botswana: the effect of international trade prohibition. Ecological Economics. 18(3): 215–230.	1989–1992	Botswana	Africa	recreation; hunting (safari hunting by quota, licenced hunting by country nationals by quota, culling programme)	use value only (direct use only); market price method; opportunity costs (of alternative elephant non-consumptive use); other valuation methods (shadow pricing)	Economic cost of government expenditures attributable to elephant management: USD 7.52/m^2 in 1992, expected to rise to USD 116/m^2 over 15 years (2007); Net present value (value added over 15 years to national income, net of government expenditures, after discounting at 6% and after shadow pricing) ranging from GBP 99.8 million (1992) to GBP 202.3 million (1992), with tourism the main contributor to the economic present values of elephant use in Botswana.
9	R. Costanza, R., d'Arge, R., de Groot, R., Farberk, S., Grasso, M., Hannon, B., Limburg, K., Naeem, S., O'Neill, R.V., Paruelo, J., Raskin, R.G., Sutton, P. and van den Belt, M. 1997. The value of the world's ecosystem services and natural capital. Nature. 387: 253–260.	1997	Global	World	foods; fibres; forest timber; horticulture; biodiversity/genetic resources; other provisioning services; pollution control; climate regulation; water flow regulation; soil regulation; other regulating services; amenities; recreation; spiritual	Total Economic Value (TEV); benefit transfer; aggregation across services	For the entire biosphere, the value (most of which is outside the market) is estimated to be in the range of USD 16–54 trillion (2012)/yr, with an average of USD 33 trillion/yr. Because of the nature of the uncertainties, this must be considered a minimum estimate. Global gross national product total is around USD 18 trillion/yr.

Case study	Source	Study period	Location of case study	UN world region	Ecosystem services	Valuation methodology	Estimated costs, currency, year of currency estimate
10	Garrod, G.D. and Willis, K.G. 1997. The non-use value of enhancing forest biodiversity – A contingent ranking study. Ecological Economics. 21: 45–61.	1995	Great Britain	Europe	biodiversity/ genetic resources	Total economic Value (TEV); other valuation method (discrete-choice contingent ranking approach)	Estimated WTP for an additional unit of Standard A (basic standard of biodiversity conservation) forest varied between GBP 30.3 and 33.4/yr; while for Standard B (desired standard of biodiversity conservation) forest it varied between GBP 51.7 and 56.4/yr. WTP was lowest for Standard C (conversion to native woodland) forest, varying between GBP 18.5 and 20.7/yr. These estimates were almost certainly inflated due to non-response bias, and 'true' values may more closely correspond to those in Table 4.
11	Anda, A., 1999. Why the new mining regulations can not yet assure a successful mine rehabilitation? An analysis of the regulatory framework of mine rehabilitation in the Philippines. Unpublished. Quezon City, Philippines.	1999	Philippines (Benguet)	Asia	mining	n/a	n/a

Case study	Source	Study period	Location of case study	UN world region	Ecosystem services	Valuation methodology	Estimated costs, currency, year of currency estimate
12	Blamey, J., Rolfe, J., Bennett, J. and Morrison M. 2000. Valuing remnant vegetation in Central Queensland using choice modelling. The Australian Journal of Agriculture and Resource Economics. 44(3): 439–456.	2000	Australia (Desert Uplands region)	Oceania	pastoralism/meat	Total Economic Value (TEV); choice experiment	Implicit price for the attributes for a one unit improvement: ▪ Jobs lost in local region: AUD 3.04 ▪ Loss in regional income (AUS million): AUD 5.60 ▪ Number of endangered species lost: AUD 11.39 ▪ Percentage reduction in population of non-threatened species: AUD 1.69 ▪ Percentage loss in area of unique ecosystems: AUD 3.68 Willingness to pay for more stringent tree clearing guidelines ranging from AUD 76/household to AUD 117/household
13	Kulshreshtha, K., Lac, S., Johnston, M. and Kinar, C. 2000. Carbon sequestration in protected areas of Canada: An economic valuation. Economic Framework Project Report 549. Parks Canada. Warsaw, Ontario, Canada.	2000	Canada	Americas	climate regulation	Total Economic Value (TEV); replacement cost method; benefit transfer	Average value of carbon in this study was based on replacement and substitute cost methods. Forests were taken as the most logical replacement for sequestration. Reforestation was assumed. A cost of CDN 16.25/tonne (CDN 2005) was estimated for this option. The next best option was converting the marginal agricultural lands into forests through afforestation. This option was CDN 17.50/tonne. In addition to the median values, carbon sequestered was evaluated at a low price scenario – CDN 2.30–3.00/tonne and under a high price scenario, CDN 500/tonne.

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14	CBD. 2001. The value of forest ecosystems. CBD Technical Series No. 4. Secretariat of the Convention on Biodiversity. Montreal, Canada.	2001	Global	World	forest timber (timber, fuelwood); NTFP; other provisioning services (charcoal); climate regulation; water flow regulation (watershed protection); recreation	Total Economic Value (TEV); benefit transfer; aggregation across services	USD 40 per ha per year for fuelwood, 20–4400/ha/yr in tropical forests and USD -4000–700/ha/yr in temperate forests, USD 0–100/ha/yr in tropical forests, and USD 15–850/ha/yr for watershed benefits ▪ Fuelwood: USD 40/ha/yr in tropical forests Non-timber forest products: USD 0–100/ha/yr in tropical forests ▪ Genetic information: USD 0–3,000/ha/yr in tropical forests ▪ Recreation: USD 2–470 for tropical forests; USD 770 for tropical forests near towns; USD 1000 for unique tropical forests; USD 80/ha/yr in temperate forests ▪ Watershed benefits: USD 15–850/ha/yr in tropical forests; USD 10–50/ha/yr in temperate forests ▪ Climate benefits: USD 360–2200/ha/yr (gross present value of one-off payment in initial year) in tropical forests and USD 90–400/ha/yr (afforestation) in temperate forests ▪ Option value: USD 70/ha/yr in temperate forest ▪ Existence value: USD 2–45/ha/yr and USD 4400/ha/yr for unique sites
15	Herath, G., 2001. Estimating the user cost of soil erosion in tea smallholdings in Sri Lanka. Australian Journal of Regional Studies 7(1): 97–111.	1999–2000	Sri Lanka	Asia	foods	use value only; dose-response method; market price method	Marginal user costs ranging from LKR Rs 0–73321.19/cm/ha; Aggregate: LKR Rs 73.1 million/yr

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16	Kreuter, U.P., Harris, H.G., Matlock, M.D. and Lacey, R.E. 2001. Change in ecosystem service values in the San Antonio area, Texas. Ecological Economics. 39: 333–346.	based on data from 1982–1997	Texas (San Antonio), United States of America	Americas	foods; fibres; forest timber; horticulture; biodiversity/ genetic resources; pollution control; climate regulation; water flow regulation; soil regulation; amenities; recreation	Total Economic Value (TEV); benefit transfer	Total ecosystem service values around USD 22 million/yr. Climate benefits: USD 360–2200/ha/yr (gross present value of one-off payment in initial year) in tropical forests and USD 90–400/ha/yr (afforestation) in temperate forests
17	Barnes, J., MacGregor, J. and Weaver, L.C. 2002. Economic efficiency and incentives for change within Namibia's Community Wildlife Initiatives. World Development. 30(4): 667–681.	2001	Namibia	Africa	pastoralism/meat; hunting	Total Economic Value (TEV); market price method; opportunity costs (of conservancy resource use); other valuation method (non-use value, donor-funded)	Internal rate of return (depending on the activity): Economic: 22–132%; Financial (project): 8–19%; Financial (community): 23–220% Receipt by conservancies of donor grants enhances returns, but only in weakly viable conservancies would removal jeopardise financial incentives to participate. In three or four of the five conservancies, direct use values should be sufficient to attract community investment.

Case study	Source	Study period	Location of case study	UN world region	Ecosystem services	Valuation methodology	Estimated costs, currency, year of currency estimate
18	Berry, L., Olson, J. and Campbell, D., 2003. Assessing the extent, cost and impact of land degradation at the national level: findings and lessons learned from seven pilot case studies. Global Mechanism, Rome, Italy.	2003 (based on data from 1986-1999)	China, Ethiopia, Mexico, Uganda, Rwanda, Chile, Indonesia	World	soil regulation	use value only; opportunity costs	3–7% of agricultural GDP ▪ China – Cost of land degradation: USD 7.76 billion direct/USD 31 billion indirect/4% GDP; Level of response: USD 1–2 billion annually; Type of response: forestry, physical structures ▪ Ethiopia highlands – Cost of land degradation: 4% GDP direct/acute poverty; Level of response: 0.2–0.5% Ag GDP; Type of response: fertiliser, physical structures ▪ Mexico – Cost of land degradation: USD 3.5 billion/migration; Level of response: varied/hard to quantify; Type of response: policy change, reforestation ▪ Uganda – Cost of land degradation: 4% GNP?; Level of response: hard to quantify; Type of response: policy, terracing in SW ▪ Rwanda – Cost of land degradation: 3.5% Ag GDP direct/acute poverty; Level of response: hard to quantify; Type of response: centralised terracing policy ▪ Chile (Coquimbo) – Cost of land degradation: 50% on wheat/23% goat; Level of response: not known; Type of response: not known ▪ Indonesia – Cost of land degradation: 0–4% crop value; Level of response: not known; Type of response: long term soil & water management

Case study	Source	Study period	Location of case study	UN world region	Ecosystem services	Valuation methodology	Estimated costs, currency, year of currency estimate
19	Turpie, J.K. 2003. The existence value of biodiversity in South Africa: how interest, experience, knowledge, income and perceived level of threat influence local willingness to pay. Ecological Economics. 46(2): 199–216.	2002	South Africa	Africa	biodiversity/genetic resources	Total Economic Value (TEV); contingent valuation	WTP for conservation was relatively high (USD 3.3 million/yr for fynbos, 58 million for national biodiversity), and comparable with government conservation budgets. WTP increased dramatically (to up to USD 15 million and 263 million/yr, respectively) when respondents were faced with the predicted impacts of climate change on biodiversity.
20	Adebisi, A., 2004. A case study of Garcinia kola nut produc-tion-to-consumption system in J4 area of Omo Forest Reserve, south-west Nigeria (Chapter 7). In: Sunderland, T. and Ndoye, O., Forest products, livelihoods and conservation: Case studies from non-timber forest products. CIFOR, Bogor, Indonesia.	based on data from 1990-1999	Nigeria (Omo Forest Reserve, Southwest Nigeria)	Africa	NTFP (Garcinia kola Heckel nuts also known as 'bitter kola'); other cultural services	use value only; market price method	NGN 537.5–687.5 (USD 5.37–6.87)/25 kg basket or about 2,500 nuts at farm gate; to NGN 2,016–2,383 (USD 20.16–23.83)/25 kg basket or about 2,500 nuts from itinerant vendor
21	Deininger, K.and Chamorro, J.S., 2004. Investment and equity effects of land regularisation: the case of Nicaragua. Agricultural Economics. 30(2): 101–116.	based on data from 2000	Nicaragua	Americas	foods; forest timber; pastoralism/meat; soil regulation (fallow land)	use value only; market price method	Receipt of registered title is found to increase land values by 30% and at the same time greatly increase the propensity to invest, bringing such investment closer to the optimum

Case study	Source	Study period	Location of case study	UN world region	Ecosystem services	Valuation methodology	Estimated costs, currency, year of currency estimate
22	Holden, S.and Shiferaw, B., 2004. Land degradation, drought and food security in a less-favoured area in the Ethiopian highlands: a bio-economic model with market imperfections. Agricultural Economics. 30(1): 31–49.	2002 (based on data from 1986-2000)	Ethiopia (highlands)	Africa	foods; pastoralism/ meat	use value only; market price method; opportu-nity costs	ETB 2139 (no credit constraint) to ETB 2679 (credit constraint) lost in drought year (resp 0.79 and 0.99% of poverty line). Losses increase to ETB 2408 (no credit constraint) to ETB 2558 (credit constraint) the 4th year after the drought year (resp 0.81 and 0.86% of poverty line).
23	Morales, C., Dascal, G., Aranibar, Z. and Morera, R., 2000. Measuring the economic costs of land degradation and desertification in selected South American countries. Secheresse. 23(3): 168–176.	based on data from 1985-2008	Latin America/ Caribbean	Americas	foods; pastoralism/meat	use value only; opportunity costs	Land degradation lowers agricultural GDP by 8–14% annually

Case study	Source	Study period	Location of case study	UN world region	Ecosystem services	Valuation methodology	Estimated costs, currency, year of currency estimate
24	Spencely, A. & Barnes, J. 2005. Economic analysis of rhino conservation in a land-use context region. SADC Regional Programme for Rhino Conservation. Harare, Zimbabwe.	2005	South Africa, Zimbabwe, Swaziland, Tanzania, Malawi, Botswana, Zambia	Africa	recreation; hunting	use value only; market price method	Contribution of 0.46–.060 (USD 2004) per ha/yr. Cumulative net profit from the sale of 243 white rhino from Hluhluwe-Imfolozi since 2000 was USD 4,995,441, while the net profit from 13 black rhino was USD 687,73123 (public management). It should be noted that this revenue does not accrue directly to Hluhluwe-Imfolozi Park, but centrally to KZN Wildlife. Thus, profit generated by increased rhino populations due to conservation management in Hluhluwe-Imfolozi is used for the benefit of other protected areas in the province too. Since 2002, Phinda (a private company) has sold 14 white rhino through negotiated sales. The average price over 3 years was USD 17,256, providing a total turnover of USD 241,000, and a net profit of USD 192,800 after deducting costs. Note Phinda's perception that customers pay premium values for Phinda's rhino because they were habituated to vehicles (pers. comm. Pretorius, 2005).
25	Turpie, J.K., Ngaga, Y.M. & Karanja, F.K. 2005. Catchment ecosystems and downstream water: The value of water resources in the Pangani Basin, Tanzania. Water, Nature and Economics Technical Paper No. 7, IUCN. Gland, Switzerland,	2003	Tanzania (Pangani Basin)	Africa	water supply	use value only; market price method; benefit transfer	Depends on usage considered – Agriculture alone contributes TZS 3,310,977 million (10,000 TZS = 1 USD (2003)). Value of water TZS 1–2 million/ha.

Case study	Source	Study period	Location of case study	UN world region	Ecosystem services	Valuation methodology	Estimated costs, currency, year of currency estimate
26	Costanza, R., Wilson, M., Troy, A., Voinov, A., Liu, S. and D'Agostino, J. 2006. The value of New Jersey's ecosystem services and natural capital. Gund Institute for Ecological Economics. Vermont, United States.	2004-2006	New Jersey, United States	Americas	water flow regulation; pollution control; soil regulation; other regulating services; recreation; amenity	Total Economic Value (TEV); hedonic price method; benefit transfer; aggregation across services	The services provided by New Jersey's ecosystems are worth, at a minimum, USD 11.6–19.4 billion/year. For the most part, these services are not currently accounted for in market transactions.
27	IUCN. 2006. Hidden cost is value lost. The economic importance of dryland goods and services in the IGAD region [Policy brief]. International Union for the Conservation of Nature. Gland, Switzerland.	2006	IGAD region	Africa	pastoralism/meat; water flow regulation; soil regulation; climate regulation; other regulating services (movement of wildlife and human communities)	use value only; benefit transfer	An estimate of the value of goods and services derived annually from dryland ecosystems through the production of livestock within each IGAD country shows that the average asset value of the drylands is about USD 1,500–4,500/ha (USD 2007).
28	Odhiambo, M. 2006. Review of the literature on pastoral economics and marketing: Kenya, Tanzania, Uganda and the Sudan. Report prepared for the World Initiative for Sustainable Pastoralism, IUCN EARO RECONCILE, Kenya.	2006	Kenya, Tanzania, Uganda, Sudan	Africa	pastoralism/meat	use value only; other valuation method (%GDP)	Total contribution of pastoralism for livestock production in Kenya is KES 4,852 million (about 8% of the total livestock sector value).

Case study	Source	Study period	Location of case study	UN world region	Ecosystem services	Valuation methodology	Estimated costs, currency, year of currency estimate
29	Campos, P., Daly-Hassen, H. and Ovando, P., 2007. Cork oak forest management in Spain and Tunisia: Two case studies of conflicts between sustain-ability and private income. International Forestry Review. 9(2): 610–626.	2007	Spain (Cadiz), Tunisia (Ain Snoussi)	Europe	NTFP (cork); hunting; other cultural services	use value only; market price method; opportunity costs	Capital gain/loss from cork oak forest permanent natural regeneration versus cork oak depletion (EUR 2002/ha, present discounted values): ranging from EUR -5,253.7/ha (10% discount rate) to EUR 14,890.3/ha (1% discount rate).
30	Davies, J. 2007. Total economic valuation of Kenyan pastoral-ism. World Initiative for Sustainable Pastoralism. Global Environment Facility, UNEP, and IUCN.	based on data from 1997-2006	Kenya	Africa	foods; forest timber; pastoralism/meat; biodiversity/ genetic resources; other provisioning services; honey; climate regulation; other regulating services	Total Economic Value (TEV); contingent valuation; market price method; mitigation costs; opportunity costs	USD 499/houselhold/yr for ecosystems; USD 40,625/houselhold/yr for Livestock assets; USD 482/houselhold/yr for livestock sales; USD 3,588/houselhold/yr for livestock products; USD 5,578/houselhold/yr for tree/ forest resources; USD 63/houselhold/yr for agricultural production
31	Diao X. and Sarpong D.B., 2007. Cost implications of agricultur-al land degradation in Ghana. IFPRI Discussion Paper 698. International Food Policy Research Institute, Washing-ton, D.C.	data from 1989/1999 and 2000-2004	Ghana	Africa	foods; pastoralism/meat; soil regulation	use value only; other valuation method (economy-wide multimarket model)	Land degradation reduces agricultural income in Ghana by a total of USD 4.2 billion over the period 2006–2015, which is approximately five percent of total agricul-tural GDP in these ten years. Soil loss is predicted to increases the poverty rate by 5.4 percentage point in 2015

Case study	Source	Study period	Location of case study	UN world region	Ecosystem services	Valuation methodology	Estimated costs, currency, year of currency estimate
32	Do, T.N., 2007. Impacts of dykes on wetland values in Vietnam's Mekong River Delta: A case study in the Plain of Reeds (PhD Thesis). Economy and Environment Program for Southeast Asia, Singapore.	based on surveys in 2006	Vietnam (Tram Chim National Park, Plain of Reeds/Mekong River Delta)	Asia	foods; biodiversity/ genetic resources; other regulating services (general ecosystem health)	Total Economic Value (TEV); market price method (costs); dose-response method (production function); choice experiment (social benefits); other valuation method (costs of action, transaction costs)	The proposed park dyke conversion of Tram Chim would reduce rice yield by 0.03 tonnes/ha/yr or 1,500 tonnes/yr for local farmers in an adjacent area of 50,000 ha around the park. This income loss of about USD 91,875/yr, together with compensation paid by the government for "farmer changing livelihood" costs (costs of adapting to new conditions/jobs after the dyke conversion) and engineering costs, brings the total costs of the proposed five-year programme to USD 3.4 million. On the other hand, respondents are willing to pay for increased biodiversity values of Tram Chim resulting from the proposed changes in dyke and wetland management. The aggregated non-market values range from USD 3.94–5 million, suggesting that the park dyke conversion can generate a net social benefit.The conversion from high to low farm dykes would reduce rice yields by 0.24 tonnes per ha/yr or VND 0.98 million per household/yr. In addition, it would reduce the income from livestock rearing. The estimated cost of the dyke conversion would be VND 15.4 million/household/yr and VND 614 billion or USD 38.4 million for the whole Mekong River Delta. On the other hand, the biodiversity values of all wetlands in the Mekong River Delta were estimated at USD 41.7 million and USD 53 million for the lower and higher bounds respectively. Therefore, the net social benefits would range from about USD 3.3–14.6 million.

Case study	Source	Study period	Location of case study	UN world region	Ecosystem services	Valuation methodology	Estimated costs, currency, year of currency estimate
33	Hein, L. 2007. Assessing the costs of land degradation: a case study for the Puentes catchment, southeast Spain. Land Degradation and Development. 18(6): 631–642.	2003	Spain (Puentes catchment, southeastern Spain)	Europe	foods; pastoralism/ meat; horticulture; water flow regulation; soil regulation; recreation; hunting	use value only; market price method; replace-ment cost method	EUR 8–1350/ha/yr (2006). The costs of erosion on cropland vary from around EUR 5/ha/yr on slopes between 5 and 10%, to around EUR 50/ha/yr on slopes between 30 and 50%.
34	Naidoo, R. & Iwamura, T. 2007. Global-scale mapping of economic benefits from agricultural lands: Implica-tions for conservation priorities. Biological Conser-vation. 140: 409–49.	based on data from 2005	Global	World	foods; pastoralism/ meat	opportunity costs	Varied from 0–6,480/ha, with a mean 55/ha/yr and standard deviation of 130/ha/yr (USD 2005)
35	Takimoto. 2007. Carbon sequestration potential of agroforestry systems in the West African Sahel: An assessment of biological and socioeconomic feasibility (Doctoral thesis). University of Florida. Gainesville, USA.	2003-2007	Sahel	Africa	climate regulation	use value only; market price method	Carbon sales changed the profitability: USD 13.9 more in net present value (NPV) of average-size live fence (291 m), and 20.5 more in NPV of average size fodder bank (0.25 ha). With the accounting method that is in favor for the investors, the expected profits from carbon sales in the same model produced an increase in NPV of only about USD 0.3 in both systems, which is almost nothing for a 25-year project even in the local currency with farmer's monetary values. Sensitivity analysis and risk analysis showed that carbon price did not have a major influence on changing the cost and benefit flow of both systems.

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36	Tilahun, M., Olschewski, R., Kleinn, C. and Gebrehiwot, K., 2007. Economic analysis of closing degraded Boswellia papyrifera dry forest from human intervention: A study from Tigray, Northern Ethiopia. Forest Policy and Economics. 9: 996–1005.	2003	Ethiopia (Tigray, Tanqua Abergelle)	Africa	foods; forest timber; pastoralism/meat; NFTP (frankin-cense)	use value only; market price method; dose-response method	The financial Net Present Values were 8622 ETB/ha for closed and 6468 ETB/ha for open forestlands. Rural households earn about 74% of the annual total revenue (ETB/ha) from closed and open area as wage for tapping and collecting frankincense and using of grass.
37	Ying, Z., 2007. The optimal forest ecological programming in Hainan Province. Forestry Economics. 176(03): 49–52.	2007	China (Hainan province)	Asia	forest timber; biodiversity/genetic resources; water flow regulation; soil regulation; climate mitigation; other regulating services (air purification capacity); other cultural services	use value only; other valuation method (shadow price)	The average shadow price reasonably used for forestlands of different kind of forests is CNY 2512.46/ha, and the optimal estimation price for special purpose forest is CNY 4376.04/ha, which is not CNY 6888.50/ha currently.

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38	Omondi, I., Baltenweck, I., Drucker, A.G., Obare, G. and Zander K.K. 2008. Economic valuation of sheep genetic resources: Implications for sustainable utilisation. Tropical Animal Health and Production. 40: 615–626.	2006–2007	Kenya (Marsabit district)	Africa	other provisioning services (value of sheep genetic characteristics)	use value only; choice experiment	Disease resistance implicit value for welfare improvement of up to KShs 1537 more for animals that never get ill in the rainy season, which is similar to the actual average cost paid by the livestock keepers (KShs 1898) with regards to health care of their stock (purchasing veterinary drugs and services – including tick control). These higher costs are passed onto livestock producers because of market imperfections caused by high transaction costs incurred by the players in the animal health products and services market. These transaction costs, which might be as a result of poor infrastructure that characterise the study area, are seemingly transferred to the livestock producers who resultantly pay more than they are willing to pay. Drought tolerance (animal's "body condition in dry season"): implicitly valued at KShs 694 more for strong/good tolerance (pin bones and ribs not outstandingly visible) than weak/poor tolerance (bony with very conspicuous ribs), which is lower than the loss incurred from the death of a sheep from drought (perceived equal to KShs959 by the pastoralists). It is therefore economically worth improving and/or managing drought tolerance in sheep. Fat deposition trait: implicitly valued at KShs 738 more for an animal body full of fat (mainly around ribs, brisket/breast, belly) than not full of fat. Body conformation ("rump shape and size"): implicitly valued at KShs 548 more for rumps that are big round and erect/raised towards the rear end than for rumps that are small and sloping downwards towards the rear end.

Case study	Source	Study period	Location of case study	UN world region	Ecosystem services	Valuation methodology	Estimated costs, currency, year of currency estimate
39	Rodriguez, L. 2008 A global perspective on the total economic value of pastoralism: Global synthesis report based on six country valuations. IUCN. Nairobi, Kenya.	2006–2008	Ethiopia, Iran, Kyrgyzstan, Mali, Peru, Spain	World	pastoralism/meat; recreation	use value only; other valuation method (%GDP)	Results indicate, that despite the widespread opinion of pastoralism as not being an economically viable or rational livelihood, it contributes significantly to GDP in many developing countries, e.g., ~8.5% in Uganda, 9% in Ethiopia,10% in Mali. Economic contributions of pastoralism depends on importance of livestock and agricultural sector.
40	Borresch, R., Maas, S., Schmitz, K. and Schmitz, P.M. 2009. Modelling the value of a multifunctional landscape - A discrete choice experiment. Contributed paper prepared for presentation at the International Association of Agricultural Economists Conference (Aug 16–22), Beijing, China.	2007	Germany (Wetterau region)	Europe	biodiversity/ genetic resources (plant and animal biodiversity); water flow regulation; amenity	Total Economic Value (TEV); choice experiment; opportunity costs	Implicit prices of landscape functions: - Plant biodiversity (per plant species): EUR 1.58 for a change to the next better level. - Animal biodiversity (per % animal species): EUR 3.26 for a change to the next better level - Water quality (per mg/l nitrate): EUR 4.24 for a change to the next better level Implicit prices of landscape aesthetics (change from current landscape aesthetics to): - Grassland dominated landscape: EUR 48.48 - Multifunctionality scenario: EUR 87.68 - High price scenario (with high rate of cereals area): EUR -16.43 - Intensive scenario (with larger fields): EUR -13.17 Negative values indicate that the respondent has to be compensated to accept the change to the landscape aesthetics (corresponds to willingness to accept for total scenarios).

Case study	Source	Study period	Location of case study	UN world region	Ecosystem services	Valuation methodology	Estimated costs, currency, year of currency estimate
41	Brainard,J., IBateman, I.J. and Lovett, A.A. 2009. The social value of carbon sequestered in Great Britain's woodlands. Ecological Economics. 68: 1257–1267.	based on data from 2001	Great Britain	Europe	climate regulation	use value only; other valuation method (social value of carbon)	The minimum suggested NPV (discount rate = 3% and social value of carbon = 1 (USD) of GB woodlands already existing in 2001 is USD 82 million, with a further USD 72 million that might be added by future afforestation. These figures rise dramatically if a discount rate of 1% and social value of sequestered carbon = 109.5/t (USD) are assumed.
42	Emerton, L., Erdenesaikhan, N., De Veen, B., Tsogoo, D., Janchivdorj, L., Suvd, P., Enkhtsetseg, B., Gandolgor, G., Dorisuren, C., Sainbayar, D. and Enkhbaatar., A. 2009. The economic value of the Upper Tuul Ecosystem (Mongolia). Mongolia Discussion Papers, East Asia and Pacific Sustain-able Development Depeart-ment. The International Bank for Reconstruction and Development. Washington, D.C.	2008–2009	Upper Tuul Region, Mongolia	Asia	forest timber; pastoralism/meat; NTFP; water supply; recreation; hunting	use value only; market price method; aggregation across services	The study found that the land and resources of the Upper Tuul currently contribute income and marketed products worth around MNT 28 billion/yr in tourism, herding, and forest-based sectors. Meanwhile, the value of water use in Ulaanbaatar is estimated to be worth MNT 90 billion/yr at the minimum.
43	Feto, M.S., 2009. The role of non timber forest products to rural livelihoods and forest conservation: A case study at Harana Bulluk District Oromia National Regional State, Ethiopia (M.Sc. Thesis). Wondo Genet College of Forestry and Natural Resource, Wondo Genet, Ethiopia.	based on data from 2007–2008	Ethiopia (Harana Bulluk District, Oromia National Regional State)	Africa	foods; pastoralism/meat; horticulture (coffee); honey; other provisioning services	use value only; market price method (substitute goods)	The total average annual household income is ETB 22,206. In terms of contribution to the household annual income, crop production, NTFPs (forest products), and livestock and off farm contributed in the order of their importance 44 %, 35%, 14%, and 7% to the annual household income, respectively.

Case study	Source	Study period	Location of case study	UN world region	Ecosystem services	Valuation methodology	Estimated costs, currency, year of currency estimate
44	Mmopelwa, G., Blignaut, J.N. and Hassan, R. 2009. South African Journal of Economic and Management Sciences. 12(2): 242–255.	based on data from 2003	Botswana (Okavango Delta)	Africa	foods; fibers; forest timber; other provisioning services	use value only; market price method	The average annual direct use value per household of native plants harvested, such as palm leaves for basketry, grass for thatching, fuelwood, edible fruits and plant parts used by three villages adjacent to the Okavango Delta during the 2003 calendar year is estimated at USD 1,434/household/yr (or USD 43.41/ha/yr). This value is almost equal to the average household financial income of USD 1,416/year. The net present value of the overall benefit from the direct use of the vegetative resources is estimated at USD 101.9 million.
45	Norton-Griffiths, M. and Said, M.Y., 2009. The future for wildlife on Kenya's rangelands: An economic perspective, in Wild Rangelands: Conserving wildlife while maintaining livestock in semi-arid ecosystems (eds; du Toit, J.T., Kock, R. and Deutsch, J.C.), John Wiley and Sons Ltd, Chichester, UK.	2009	Kenya	Africa	foods; pastoralism/meat; recreation	use value only; market price method; opportunity costs	Agricultural: 1.93 billion of potential rents (= Differential net returns to production* area potentially available for cultivation outside of the protected areas), 670 million/yr (35% of potential) have been fully captured. Livestock: 573 million/yr. Wildlife: concession and access fees paid to landholders by the tourism cartels average 10.2/ha/yr but are sometimes as high as 50/ha/yr. Potential wildlife rents to land-holders (= Differential net returns to production* areas of the rangelands actually used by tourists) of between 20–100 million/yr.

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46	Sayadi, S., González-Roa, M.C. and Calatrava-Requena, J., 2009. Public preferences for landscape features: The case of agricultural landscape in mountainous Mediterranean areas. Land Use Policy. 26(2): 334–344.	2002	Spain (mountain area of the Alpujarras)	Europe	amenity	(part of) use value only; contingent valuation	Average WTP of EUR 31.60/day for accommodations with views of the most highly appreciated landscape (landscapes with an irrigation agricultural component on an intermediate slope with a village or traditional houses visible in the landscape); Average WTP of EUR 21.48/day for the least valued, i.e., landscapes of abandoned agricultural lands without any village in view and with a steep slope
47	SOS Sahel Ethiopia. 2009. Pastoralism in Ethiopia: It's total economic value and development challenges. World Initiative for Sustainable Pastoralism – GEF UNEP and IUCN.	2009	Ethiopia	Africa	pastoralism/meat; fibers; NFTP; recreation; other cultural services	use value only; market price method; contingent valuation	The sample households estimate the current value of their livestock holding at ETB 3.57 million. Mean and total maximum willingness to pay by the pastoral households to conserve the Existing Pasture lands is ETB 148.13 and 10,221/yr, respectively. Alternatively, pastoral households are willing to contribute some amount of livestock in order to conserve existing pasturelands. The average and total maximum amount of money that the pastoral households are willing to pay per annum is ETB 133 and 9,070, respectively, to improve the existing pasturelands. Given the total pastoral households (about 1.9 million), the total amount of money pastoral households are willing to pay for the improvement of the existing pasturelands is ETB 253 million (USD 28.1 million) per annum.

Case study	Source	Study period	Location of case study	UN world region	Ecosystem services	Valuation methodology	Estimated costs, currency, year of currency estimate
48	Tilahun, M., Vranken, L., Muys, B., Deckers, J., Gebregziabher, K., K. Gebrehiwot, K., Bauer, H.and Mathijs, E., 2013. Rural households' demand for frankincense forest conservation in Tigray, Ethiopia: A contingent valuation analysis. Land Degradation and Development (online).	2009	Ethiopia (Tigray)	Africa	NTFP (frankincense)	Total Economic Value (TEV); contingent valuation	A household is willing to pay at least USD 4.86/household/yr or contribute 7.17 labour days/household/yr which amounts to USD 6.64/household/yr at per capita daily income.
49	Adams, V.M., Pressey, R.L. & Naidoo, R. 2010. Opportunity costs: Who really pays for conservation? Biological Conservation. 143: 439–448.	2010	Paraguay (Mbaracayu Forest Biosphere Reserve)	Americas	foods; pastoralism/meat	use value only; opportunity costs; aggregation across services	Total opportunity costs for the studied area (nearly 300,000 ha) range from 2,500,000–6,000,000 (USD) summed across three land uses: small holder agriculture, ranching, and soybean farming, depending on the scenario considered.
50	Batker, D., Kocian, M., McFadden, J. and Schmidt, R. 2010. Valuing the Puget Sound basin – Revealing our best investments. Earth Economics. Tacoma, USA.	2008–2010 (improving a 2008 study)	Washington State (Puget Sound), USA	Americas	biodiversity/ genetic resources; other provisioning resources (medical); water flow regulation; soil regulation; climate regulation; pollution control; recreation; amenity	Total Economic Value (TEV); benefit transfer; aggregation across services	Partial valuation of 14 ecosystem services across 17 land cover types in the Puget Sound Basin shows an annual flow of USD 9.7–83 billion. Estimates of the present value of ecosystem service of the Puget Sound Basin range from USD 967 billion to 8.3 trillion for a 0% discount rate over 100 years; and from USD 305 billion to 2.6 trillion for a 3% discount rate over 100 years.

Case study	Source	Study period	Location of case study	UN world region	Ecosystem services	Valuation methodology	Estimated costs, currency, year of currency estimate
51	Bharucha, Z. and Pretty, J. 2010. The roles and values of wild food in agricultural systems. Philosophical Transactions of the Royal Society. 365: 2913–2926.	2010 (based on data from 1980–2009)	Asia and Africa	Asia and Africa	other provisioning services (wild-foods)	use value only; benefit transfer	From the limited data available, it is clear that wild plants and animals can provide USD 170–900 (USD 2009) worth of value to rural households in South Africa and Tanzania. In Ghana, the bushmeat market is worth USD 275 million annually.
52	Brander, L. and Schuyt, K. 2010. TEEBCase: Benefits Transfer: The economic value of the world's wetlands. TEEB. Geneva, Switzerland.	2010	Global	World	foods; water supply; biodiversity/ genetic resources; other provisioning services; water flow regulation; soil regulation; climate regulation; pollution control; other regulating services; recreation; spiritual; amenity; other cultural services	Total Economic Value (TEV); benefit transfer	The total economic value of 63 million hectares of wetland around the world was estimated at USD 3.4 billion/yr. Wetlands in Asia have the highest value at USD 1.8 billion/yr. TEV may even be higher, based on the estimate by Ramsar of global wetland area of 12.8 million km sq. In this case, the TEV of the world's wetlands can be estimated at USD 70 billion/yr. Sediment wetlands have the highest values, followed by freshwater wooded wetlands (USD 374 and USD 206/ha/yr respectively) (Schuyt and Brander, 2004). The high value of Asian wetlands can be explained by high population density, which to have a high demand for wetland goods/services, translating into higher economic values. It may also correspond to increasing pressure on biodiversity and other important wetland values (scientific, socio-cultural) as well as wetland's ecological processes. The inverse applies for Latin American wetlands, resulting in lower values. Population density is generally low in Latin America and there is a relative abundance of wetlands.

Case study	Source	Study period	Location of case study	UN world region	Ecosystem services	Valuation methodology	Estimated costs, currency, year of currency estimate
53	Brenner, J., Jimenez, J.A., Sarda, R. and Garola, A. 2010. An assessment of the non-market values of ecosystem services provided by the Catalan Coastal Zone, Spain. Ocean and Coastal Management. 53: 27–38.	2010	Spain (Catalan)	Europe	pollution control; climate regulation; water flow regulation; soil regulation; other regulating services; recreation; amenity; spiritual	Total Economic Value (TEV); benefit transfer (spatial)	In 2004 a substantial economic value of USD 3,195 million/yr was delivered to local citizens by surrounding ecosystems.
54	Birch, J.C., Newton, A.C., Aquino, C.A., Cantarello, E., Echeverría, C., Kitzberger, T., Schiappacassee, I. and Tejedor Garavitoa, N., 2010. Cost-effectiveness of dryland forest restoration evaluated by spatial analysis of ecosystem services. Proceedings of the National Academy of Sciences. 107(50): 21925–21930.	2010	Nahuel Huapi, Río Negro/ Neuquén (Argentina), El Tablon, Chiapas (Mexico), Central Veracruz (Mexico), Quilpue, Valparaíso region (Chile)	Americas	climate regulation; NFTP; forest timber; recreation; hunting; pastoralism/meat	use value only; market price method; dose-response method; opportunity cost	Net present value of ecosystem services (USD/ha/yr) for 20-y time horizon at 5% discount rate, excluding restoration costs, for: ▪ Carbon sequestration: USD 0–30/h/yr; ▪ NTFP: USD 0.045–0.065/ha/yr; ▪ timber: USD 0.1–0.8/ha/yr; ▪ tourism: USD 0.3–1.1/ha/yr; ▪ livestock production: USD -2.7–0/ha/yr. Net social benefit of restoration (i.e., the net change in value of the ecosystem services associated with land cover change minus the costs associated with reforestation): ▪ for passive restoration: USD 5–597/ha/yr; ▪ for passive restoration with protection: USD -16 to -496/ha/yr; ▪ for active restoration: USD -21–772/ha/yr.

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55	Crossman, N.D., Connor, J.D., Bryan, B.A., Summers, D.M. and Ginnivan, J., 2010. Reconfiguring an irrigation landscape to improve provision of ecosystem services. Ecological Economics. 69(5): 1031–1042.	2009	Australia (Torrumbarry Irrigation Area in northern Victoria, part of the Murray Darling Basin)	Oceania	foods; water flow regulation	use value only; dose-response method; mitigation costs; benefit transfer	Model estimates a potential increase in net present value of ecosystem services up to AUD 347 million (horizon of 30 years at discount rate of 7%.). Increase in ecosystem services include recovering 62 GL of water for environmental flows, sequestration of 10.6 million tonnes of CO_2e/year, 12 EC (µS/cm) reduction in river salinity, and 9% increase in the agriculture value. Without a spatially targeted planning approach a 20% water reduction for irrigation could result in a loss of AUD 68.7 million in economic returns to agriculture, may only be margin-ally offset by increased value of ecosystem services resulting from return of 62 GL of water to the environment.
56	Croitoru, L. and Daly-Hassen, H., 2010. Using payments for environmental services to improve conservation in a Tunisian watershed. Mountain Forum Bulletin. 10(1): 89–91.	2009	Tunisia (Barbara watershed)	Africa	foods; soil regulation	use value only; market price method; mitigation costs	Net returns from alternative land uses: ▪ Cereals with no conservation measure in gullies: TND 815/ha for farmers; TND -55/ha for national economy after sedimentation costs ▪ Cereals with stone walls in gullies: TND -330/ha for farmers; TND -430/ha for national economy after sedimentation costs ▪ Cereals with stone walls and acacia in gullies: TND -450/ha for farmers; TND -380/ha for national economy after sedimentation costs ▪ Cereals with acacia in gullies: TN 715/ha for farmers; TND 160/ha for the national economy after sed. costs

Case study	Source	Study period	Location of case study	UN world region	Ecosystem services	Valuation methodology	Estimated costs, currency, year of currency estimate
57	Mobarghei, N., Liaghati, H. and Mohseni, A.S. 2010. Estimating the water conservation value of forest ecosystems. Presented at the "World Food System – A Contribution from Europe", Sept, 14–16, 2010. Zurich, Switzerland.	2010	Iran (Caspian forest)	Asia	water supply; water flow regulation	use value only; replacement cost method	IRR 102,000 (degraded forest) – 464,00 (eroded pasture)/ha/year (IRR 2010).
58	Rolfe, J. 2010. Valuing reductions in water extractions from groundwater basins with benefit transfer: The Great Artesian Basin in Australia. Water Resources Research. 46(6): W06301.	2009	Australia (Great Artesian Basin)	Oceania	water supply; water flow regulation; climate regulation; other regulating services (biodiversity protection); other cultural services (Aboriginal cultural heritage)	use value only; benefit transfer	Direct use values for recreation and tourism: between 0.4–0.7 million/yr (AUD 2007). Biodiversity protection values for native biodiversity: AUD 10.3 million per annum for artesian spring ecosystems and 5.8 million/yr for one endangered species. Biodiversity protection values for removal of pests and weeds: value included in estimates of biodiversity benefits. Option values, for both future use and nonuse purposes: AUD 0.2 million/yr for a 0.76% change in total water stocks over 25 years. Ecosystem services linked to the reduction in greenhouse gas emissions: approximately AUD 1.14 million/yr in cost reductions to meet emission targets if reduction in greenhouse emissions is accounted for in national targets and trading caps. Cultural heritage protection values: important, but lack of data does not allow assessment. Community protection values: important, but not related to changing pressure levels.

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59	Barrow, E. and Shah, A., 2011. TEEBcase: Traditional forest restoration in Tanzania. www.teebweb.org.	2011	Tanzania (Shinyanga region)	Africa	forest timber; pastoralism/meat; biofuels; horticulture; honey; other provisioning services; climate regulation; water flow regulation; soil regulation; other cultural services	use value only; market price method; opportunity costs	The economic value of a restored Ngitili is USD 14/person/month, while national average rural consumption is USD 8.50/person/month.
60	Bennett, J., Wang X., Guaang-cui, D., Xie, C., Xu, J., Zhang, H., Guo, H.and Eigenraam, M., 2011. Improving the efficiency of land use change in China. Final Report. Australian Government. Australian Centre for International Agricultural Research. Canberra, Australia.	2009-2011	China (Sichuan province, southwest)	Asia	foods; forest timber; other provisioning services; other regulating services (air quality)	Total Economic Value (TEV); choice experiment	n/a (average cost savings of CNY 84.6 per land unit when carrying out land manage-ment and afforestation schemes).
61	Gascoigne, W.R., Hoag, D., Koontz, L., Tangen, B.A., Shaffer, T.L. and Gleason, R.A., 2011. Valuing ecosystem and economic services across land-use scenarios in the Prairie Pothole Region of the Dakotas, USA. Ecological Economics. 70(10): 1715–1725.	2010 (based on data from 2000, 2007–2008)	Prairie Pothole Region of the Dakotas, USA	Americas	biodiversity (waterfowl); climate regulation; soil regulation; recreation; hunting	use value only; dose-response method; benefit transfer	Overall net present value value ranging from USD -14.17/ha for Extensive Conversion to 3.63/ha for Aggressive Conservation.

Case study	Source	Study period	Location of case study	UN world region	Ecosystem services	Valuation methodology	Estimated costs, currency, year of currency estimate
62	Ghermandi, A. & Nunes, P. 2011. A global map of coastal recreation values: Results from a spatially explicit based meta-analysis. Fondazione Eni Enrico Mattei. Milan, Italy.	2010	Global	World	recreation	use value only; benefit transfer; aggregation across services	Estimated values for coastal ecosystems up to USD 71,112/ha/yr.
63	Kassie, M., Kohlin, G., Bulffstone, R. and Holden, S., 2011. Are soil conservation technologies "Win-Win?" A case study of Anjeni in the northern western Ethiopian highlands. Natural Resources Forum. 35: 89–99.	2001	Ethiopia (Amhara region; District: Dembecha; Location: Anjeni)	Africa	foods	use value only; dose-response method	Sustainable land management practice (Fanya juu terraces) have the potential to reduce net crop income in the range of ETB 74–128/ha.
64	Liljenstolpe., C. 2011. Valuation of environmental impacts of the Rural Development Program - A hedonic model with application of GIS. Paper prepared for the 122nd EAAE Seminar "Evidence-based agricultural and rural policy making methodological and empirical challenges of policy evaluation." Ancona, Italy.	2011	Sweden	Europe	amenity	use value only; hedonic price method	Accommodation standard SEK 0,106/upgrade ▪ Urban: SEK -0,050 when close to urban areas ▪ Animal: SEK 0,102 when animals are present on the farm ▪ Riparian with 5000 m buffer zone: SEK 0,342e–2 for increased buffer zone ▪ Cultivated land with 500 m buffer zone: SEK -0,030 for increased buffer zone ▪ Semi natural pastures with 300 m buffer zone: SEK -0,452e–2 for increased buffer zone ▪ Grazing lands with 300 m buffer zone: SEK -0,408e–2 for increased buffer zone.

Case study	Source	Study period	Location of case study	UN world region	Ecosystem services	Valuation methodology	Estimated costs, currency, year of currency estimate
65	Ma, S. and Swinton, S.M. 2011. Valuation of ecosystem services from rural land-scapes using agricultural land prices. Ecological Economics. 70: 1649–1659.	based on data from 2003–2007	Michigan (southwest), USA	Americas	foods; forest timber; pastoralism/meat; water supply; other provisioning services; water flow regulation; soil regulation; pollution control; climate regulation; other regulating services; recreation; hunting; amenity	use value only; hedonic price method	Sales price of USD 1577–108,104/ha (USD 2003).
66	Majule, A.E., Yanda, P.Z., Kangalawe, R.Y.M. and Lokina, R. 2011. Economic valuation assessment of land resources, ecosystems services and resource degradation in Tanzania. Global Mechanism. Rome, Italy.	2011	Tanzania	Africa	foods (crops and fish); forest timber; biodiversity/genetic resources; water flow regulation; climate regulation; recreation; amenity	use value only; market price method	Existence value: USD 2/ha/yr to 45/ha/yr and 4400/ha/yr (USD) for unique sites Total land cover of 7, 643, 115 ha: ▪ Provisioning services value is USD 1,449,379,389/year ▪ Water regulation value is USD 908,582,700/year ▪ Biodiversity value is USD 65,318,106,008/year ▪ Tourism &Cultural/Aesthetic value is USD 91,466,196/year ▪ Carbon sequestration (on total stock value) is USD 44, 837,504,000 ▪ Total value of 112,605,038,293, or USD 1,473,287/ha.

Case study	Source	Study period	Location of case study	UN world region	Ecosystem services	Valuation methodology	Estimated costs, currency, year of currency estimate
67	Mekuria, W., Veldkamp, E., Tilahun, M. and Olschewski, R., 2011. Economic valuation of land restoration: The case of exclosures established on communal grazing lands in Tigray, Ethiopia. Land Degradation and Development. 22(3): 334–344.	2008	Ethiopia (Northern Highlands of Tigray)	Africa	climate regulation; soil regulation	use value only; market price method; other valuation method	The Net Present Value of exclosure's ecosystem services under consideration (i.e., restore soil nutrients and to sequester carbon from the atmosphere) was about 28 per cent (USD 837) higher than alternative wheat production.
68	Ngugi, G.W., Newton, L.E. and Muasya, A.M., 2011. The contribution of forest products to dryland household economy: The case of Kiang'ombe hill forest, Kenya. Ethnobotany Research and Applications. 9: 163–180.	2011	Kenya (Kiang'ombe hill forest)	Africa	foods; fibres; forest timber; pastoralism/meat; horticulture; honey; other provisioning services; hunting; other cultural services	Total Economic Value (TEV); contingent valuation; other valuation method (participa-tory)	Average of KSh 16,175.56/household/yr (USD 256.8/household/yr).
69	Polasky, S., Nelson, E., Pennington, D. and Johnson, K.A., 2011. The impact of land-use change on ecosystem services, biodiversity and returns to landowners: A case study in the state of Minnesota. Environmental and Resource Economics. 48: 219–242.	based on data from 1992-2001	Minnesota (USA)	Americas	forest timber; climate regulation; water flow regulation; soil regulation; other regulating services; other cultural services (urban development)	use value only; dose-response method; market price method; opportunity costs	Returns to landowners are highest in a scenario with large-scale agricultural expansion. This scenario, however, gener-ated the lowest net social benefits across all scenarios considered because of large losses in stored carbon and negative impacts on water quality. Furthermore, this scenario resulted in the largest decline in habitat quality for general terrestrial biodiversity and forest songbirds.

Case study	Source	Study period	Location of case study	UN world region	Ecosystem services	Valuation methodology	Estimated costs, currency, year of currency estimate
70	Soussan, J. & Sam, C. 2011. The values of land resources in the Cardamom mountains in Cambodia. Global Mechanism. Ministry of Agriculture, Fisheries and Forests (Cambodia), Global Mechanism, Conservation International and the Asian Development Bank.	2010	Cambodia	Asia	foods; forest timber; pastoralism/meat; horticulture; NTFP; water supply; water flow regulation; climate regulation; soil regulation (fertility, erosion protection)	Total Economic Value (TEV); benefit transfer; aggregation across services	USD 5,000 (USD 2010) per ha/year.
71	Szerényi Z.M., Kerekes S., Flachner Z. and Milton S., 2011. The possibility of the economic evaluation of ecosystem services described through a domestic case study. In: Nagy, G.G. and Kiss, V. (eds.), Borrowing services from nature - Methodologies to evaluate focusing on Hungarian case studies. CEEweb for Biodiversity, Budapest, Hungary.	based on data from 1965–2010	Hungary	Europe	water flow regulation	Total Economic Value (TEV); contingent valuation; choice experiment	Contingent valuation: Average willingness to pay of HUF 6,533/household/year; ranging from HUF 2,552/household/year for non-users to HUF 7,094/household/year for users. Choice experiment: HUF 0 for reduction of flood frequency; over EUR 21.2 (HUF 5,300)/household/year for water quality improvement from medium to good/very good.

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72	Tait, P., Baskaran, R., Cullen, R. and Bicknell, K., 2011. Valuation of agricultural impacts on rivers and streams using choice modelling: A New Zealand case study. New Zealand Journal of Agricultural Research. 54(3): 143–154.	2008	New Zealand (Canterbury region)	Oceania	water flow regulation; other regulating services (health, excess nutrients in rivers)	Total Economic Value (TEV); choice experiment	Average WTP in NZD 2008 (Lower, upper quartiles of WTP distributions) for: - Risk of pathogens from animal waste 10: NZD 27/household/yr (20, 35) - low-flow irrigation impacts 1: NZD 52/household/yr (42, 66) - ecological effects of excess nutrients good: NZD 84/household/yr (62, 105) - ecological effects of excess nutrients fair: NZD 64/household/yr (50, 80) Average annual household compensating surplus in NZD 2008 (Lower, upper quartile of compensating surplus distribution): - Management fair: NZD 154 (125, 187) - Management good: NZD 213 (169, 260)
73	Watson, R. and Albon, S. (lead authors), 2011. The UK National Ecosystem Assessment: Synthesis of the Key Findings. p. 42-44. UK National Ecosystem Assessment, Cambridge.	2010	Wales (UK)	Europe	foods; forest timber; pastoralism/meat; recreation; amenity/landscape	Total Economic Value (TEV); market price method; aggregation across services	ranging from ‹ -50/ha/yr to › + 100 GBP/ha/yr.
74	Watson, R. and Albon, S. (lead authors), 2011. The UK National Ecosystem Assessment: Synthesis of the Key Findings. p. 49–52. UK National Ecosystem Assessment, Cambridge.	2010	Great Britain (UK)	Europe	foods; fibres; forest timber; biodiversity/ genetic resources; climate regulation; recreation; amenity	Total Economic Value (TEV); market price method; aggregation across services	Range from GPB -20,670/yr to GPB 32,980/yr depending on scenario.

Case study	Source	Study period	Location of case study	UN world region	Ecosystem services	Valuation methodology	Estimated costs, currency, year of currency estimate
75	WOCAT, 2011. Planting pits and stone lines: Niger – Tassa avec cordon pierreux. SWC Technology.	1999, updated 2004	Niger (Tahoua)	Africa	foods; water flow regulation; soil regulation	use value only; other valuation method (costs of action)	Establishment inputs and costs: USD 245/ha; Maintenance costs: USD 35/ha/yr.
76	Chabala, L.M., Kuntashula, E., Hamukwala, P., B.H. Chishala, B.H. and Phiri, E. 2012. Assessing the value of land and costs of degradation in Zambia (first draft). Global Mechanism (GM) and Stockholm Environment Institute (SEI).	2012	Zambia	Africa	foods (fish); forest timber; pastoralism/meat; water flow regulation (hydroelectric power generation); recreation	use value only; market price method; replacement cost method; aggregation across services	▪ Productive value is ZMK 303, 317, 906,000 ▪ Cultural & aesthetic value is ZMK 56,690,100,000 ▪ Water regulation is ZMK 840,914,000,000 ▪ Total of ZMK 1,200,922,006,000 ZMK 1 = USD 0.02 (2012)
77	DeGroot, R., Brander, L., van der Ploeg, S., Costanza, R., Bernard, F., Braat, L., Christie, M., Crossman, N., Ghermandi, A., Hein, L., Hussain, S., Kumar, P., McVittie, A., Portela, R., Rodriguez, L.C., ten Brink, P. and van Beukering, P. 2012. Global estimates of the value of ecosystems and their services in monetary units. Ecosystem services. 1: 50–61.	2012	Global	World	foods; fibers; pastoralism/meat; biofuels; biodiversity/genetic resources; other provisioning services; water flow regulation; soil regulation; climate regulation; pollution control; other regulating services; recreation; amenity; spiritual; other cultural services	Total Economic Value (TEV); benefit transfer; aggregation across services	The total value of ecosystem services is considerable and ranges between 490 int/year for the total bundle of ecosystem services that can potentially be provided by an 'average' hectare of open oceans to almost 350,000 int/year for the potential services of an 'average' hectare of coral reefs. More importantly, our results show that most of this value is outside the market and best considered as non-tradable public benefits.

Case study	Source	Study period	Location of case study	UN world region	Ecosystem services	Valuation methodology	Estimated costs, currency, year of currency estimate
78	Kaufman, M. 2012. Humboldt State University. Ecosystem service value of water supply benefits provided by forest stands in the Mattole River watershed, California: A bioeconomic and benefit transfer-spatial analysis application (Masters thesis). Humboldt State University. Arcata, USA.	2010–2012	California (Mattole River Watershed), USA	Americas	water supply	use value only; benefit transfer	The remaining old growth stands in the Mattole Watershed provide more than USD 1,910,800 a year in water supply benefits to the region.
79	Nelson, F. 2012. Natural conservationists? Evaluating the impact of pastoralist land use practices on Tanzania's wildlife economy. Pastoralism: Research, Policy and Practice. 2:15.	2011	Tanzania (northern)	Africa	recreation	use value only; benefit transfer	Annual value of pastoralist land uses to the wildlife-based tourism industry in northern Tanzania is estimated at approximately USD 83.5 million, Total value of tourism in the northern circuit is USD 547.8 million

Case study	Source	Study period	Location of case study	UN world region	Ecosystem services	Valuation methodology	Estimated costs, currency, year of currency estimate
80	Nill, D., Ackermann, K., van den Akker, E., Schöning, A., Wegner, M., van der Schaaf, C. and Pieterse, J., 2012. Water-spreading weirs for the development of degraded dry river valleys: Experience from the Sahel. Deutsche Gesell-schaft für Internationale Zusammenarbeit (GIZ), Germany.	2011	Burkina Faso, Niger, Chad (degraded dry valleys)	Africa	foods; pastoralism/meat	use value only; market price method	In Niger, average gross revenue of ~ EUR 760 per user was achieved, but variation was considerable, from EUR 200–1,900. Expenses for growing the crops still need to be deducted from these estimates. Costs of water-spreading weirs vary, depending on physiographic settings, structure, and cost for companies. In Burkina Faso and Niger, the costs per weir range from EUR 600–1,500/ha, depending on construction (e.g., with or without a ford) and physiographic setting. Individual water-spreading weirs in Burkina Faso cost on average ~12 million CFA francs (~EUR 18,000) per weir, and between 30–36 million CFA francs (EUR 46,000 and 55,000) per weir in Chad. Average annual maintenance costs are estimated to be 0.5% of construction costs. 9 weirs costing 253 million CFA francs (EUR 390,000) were built in Gagna, Burkina Faso. The value of the total production in 2010 from rainfed crops, post-rainy season crops, irrigated crops and fishing was an estimated 245 million CFA francs (EUR 370,000). Assuming that the sum of production costs, salaries and wages, and net income without weirs is 1/2–1/3 of the total production; the investments will pay for themselves within a few years.
81	WOCAT, 2013. Rooftop rainwater harvesting – concrete Tank (Tajikistan).	2011	Tajikistan (Boshkengash, Rudaki region)	Asia	other provisioning services (rainwater harvesting)	use value only; other valuation method (costs of action)	Establishment inputs and costs: USD 397.00; Maintenance costs: USD 5/yr.

Case study	Source	Study period	Location of case study	UN world region	Ecosystem services	Valuation methodology	Estimated costs, currency, year of currency estimate
82	Adhikari B, Nadella K., 2011. Ecological economics of soil erosion: A review of the current state of knowledge. Annals of the New York Academy of Sciences 2011;1219(1): 134–52.	2011	Global	World	Literature Review	Literature Review	Literature Review
83	Quillérou, E., Thomas, R. J., 2012. Costs of land degradation and benefits of land restoration: A review of valuation methods and their application. CAB Reviews: Perspectives in Agriculture, Veterinary Science, Nutrition and Natural Resources 7(060): 1–12.	2012	Global	World	Literature Review	Literature Review	Literature Review
84	Telles, T. S., Guimarães M. d. F., Dechen, S. C. F., 2011. The costs of soil erosion. Revista Brasileira de Ciência do Solo 35(2): 287–298.	2011	Brazil/Global	Americas/ World	Literature Review	Literature Review	Literature Review
85	Yamasaki, S. H., Guillon, B. M. C., Brand, D., Patil, A. M., 2010. Market-based payments for ecosystem services: current status, challenges and the way forward. CAB Reviews: Perspectives in Agriculture, Veterinary Science, Nutrition and Natural Resources 5(054): 13.	2010	Global	World	Literature Review	Literature Review	Literature Review

Case study	Source	Study period	Location of case study	UN world region	Ecosystem services	Valuation methodology	Estimated costs, currency, year of currency estimate
86	Schild, J., van der Ploeg, S., de Groot, D., 2013. Evidence For The Economic Value Of Drylands: A Meta-Analysis Of Dryland Ecosystem Services. Working paper.	2013	Global	World	Literature Review	Literature Review	Literature Review

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THE ECONOMICS OF LAND DEGRADATION

Investment in sustainable land management pays off

The Economics of Land Degradation Initiative is a global study on the economic benefits of land-based ecosystems. The initiative highlights the value of sustainable land management and provides a global approach for analysing the economics of land degradation. The ELD Initiative is uniquely positioned to make this focus an integral part of policy strategies and decision-making.

This Interim Report of the Economics of Land Degradation Initiative is a step towards a comprehensive study of the benefits of practicing sustainable land management and costs of neglecting sustainable land stewardship.

By focusing on obtaining the total economic value of land including the provision of ecosystem services, the initiative brings together a collaborative, international group of researchers, policy-makers and private business in order to alert public and private decision-makers to the forgone opportunities and associated costs of continued land degradation.

This Interim Report highlights the background to the study, including the importance of estimating the potential economic benefits derived from addressing land degradation, suggests a methodological framework whereby countries can undertake their own evaluations and briefly reviews case studies which indicate that the overall economic benefits of adopting sustainable land management far outweigh the costs involved.

The initiative will further produce three separate final reports aimed at the scientific community, policy makers, and private decision-makers.

This report was launched and presented at the Eleventh Conference of the Parties to the United Nations Convention to Combat Desertification (UNCCD COP11) held in Windhoek, Namibia in September 2013.

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