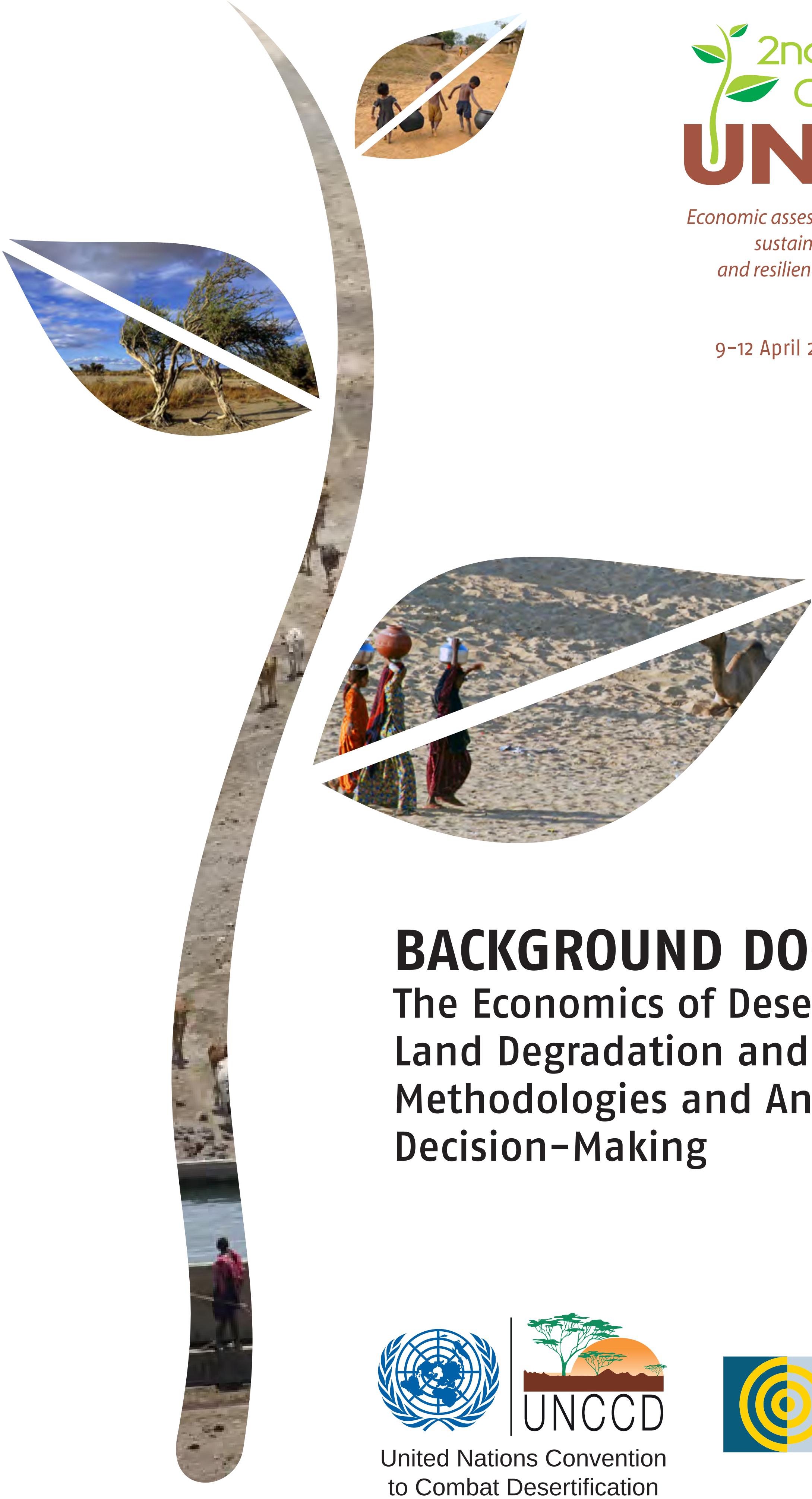

2nd Scientific Conference
UNCCD

Economic assessment of desertification, sustainable land management and resilience of arid, semi-arid and dry sub-humid areas

9–12 April 2013 – Bonn, Germany

BACKGROUND DOCUMENT

The Economics of Desertification, Land Degradation and Drought: Methodologies and Analysis for Decision-Making

UNCCD
United Nations Convention to Combat Desertification

GLOBAL RISK FORUM
GRF DAVOS
GRF

We would like to extend our sincere appreciation to, in particular, the Governments of Germany, Finland, the Republic of Korea, Spain, Sweden and Switzerland for their contributions and generous support. Voluntary financial contributions have helped in the preparation and organization of the United Nations Convention to Combat Desertification (UNCCD) 2nd Scientific Conference and are strengthening our scientific understanding of the social and economic drivers and consequences of desertification, land degradation and drought. By investing in science and ensuring the participation of scientists in the decision-making processes, these voluntary contributions have significantly advanced the implementation of the Convention.

This publication is prepared by
The Global Risk Forum GRF Davos on behalf of the UNCCD

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ABBREVIATIONS AND ACRONYMS

AMU	Arab Maghreb Union
ARIES	ARtificial Intelligence for Ecosystem Services
CBA	cost-benefit analysis
CBD	Convention on Biological Diversity
CILSS	Institution of the Permanent Inter State Committee for Drought Control in the Sahel
COP	Conference of the Parties
CRP	Conservation Reserve Programme
CSIF	Country Strategic Investment Framework
CST	Committee on Science and Technology
DALY	disability-adjusted life year
DFID	Department for International Development
DIS-EISI	Desertification Information Systems – Environmental Information circulation and monitoring System on the Internet
DLDD	desertification, land degradation and drought
ECOWAS	Economic Community of West African States
EU ETS	European Union Emissions Trading System
FAO	Food and Agriculture Organization of the United Nations
GDP	gross domestic product
GEF	Global Environment Facility
GHI	Global Hunger Index
GLADA	Global Assessment of Land Degradation and Improvement
GLADSOD	Global Assessment of Human-induced Soil Degradation
GM	Global Mechanism
GPFLR	Global Partnership on Forest Landscape Restoration
GRF Davos	Global Risk Forum GRF Davos
IFPRI	International Food Policy Research Institute
IGAD	Intergovernmental Authority on Development
InforMEA	United Nations Information Portal on Multilateral Environment Agreements
InVest	Integrated Valuation of Environmental Services and Tradeoffs
IPBES	Intergovernmental Platform on Biodiversity and Ecosystem Services
IPCC	Intergovernmental Panel on Climate Change

IRR	internal rate of return
ITQ	Individual Transferrable Fishing Quotas
IUCN	International Union for Conservation of Nature
LADA	Land Degradation Assessment in Drylands
LDC	least developed country
M&A	Monitoring and Assessments
MA	Millennium Ecosystem Assessment
MBI	market-based instrument
MEA	multilateral environmental agreements
NAP	national action programmes
NBSAP	National Biodiversity Strategies and Action Plans
NDVI	Normalized Difference Vegetation Index
NPP	net primary productivity
NRM	natural resource management
NPV	net present value
OECD	Organisation for Economic Co-operation and Development
OSS	Sahara and the Sahel Observatory
PES	payments for ecosystem services
PRAIS	performance review and assessment of implementation system
REDD	Reducing Emissions from Deforestation and Forest Degradation
SAC	Scientific Advisory Committee
SBSTA	Subsidiary Body for Scientific and Technological Advice
SBSTTA	Subsidiary Body on Scientific, Technical and Technological Advice
SEEA	System of Environmental-Economic Accounts
SFM	sustainable forest management
SLM	sustainable land management
SNA	System of National Accounts
TEEB	The Economics of Ecosystems and Biodiversity
UNCCD	United Nations Convention to Combat Desertification
UNCSD	United Nations Conference on Sustainable Development
UNDP	United Nations Development Programme
UNEMG	United Nations Environment Management Group
UNEP	United Nations Environment Programme

UNFCCC	United Nations Framework Convention on Climate Change
UNISDR	United Nations International Strategy for Disaster Reduction
UNU	United Nations University
VSL	value of statistical life
WHO	World Health Organization
WOCAT	World Overview of Conservation Approaches and Technologies
WTA	willingness to accept
WTP	willingness to pay
ZNLD	zero net land degradation

EXECUTIVE SUMMARY

Land is a vital resource for producing food, preserving biodiversity, facilitating the natural management of water systems and acting as a carbon store. Appropriate land management can protect and maximize these services for society. Conversely, desertification, land degradation and drought (DLDD) have accelerated during the twentieth and twenty-first century, particularly in arid, semi-arid and dry sub-humid areas. The underlying biophysical and anthropogenic causes of land degradation are multiple and overlapping.

To effectively tackle DLDD, its drivers should be addressed and instruments designed to incentivize the sustainable management of lands. Embedded in the understanding of the 'economics of DLDD' is a set of methodologies for assessing the true societal impacts of land degradation. These form the cornerstone for determining how to best allocate financial, technical and human resources to tackle DLDD.

To this end, the first part of the background paper estimates the costs of DLDD, or conversely, the benefits of sustainable land management (SLM), for different parts of the world. A toolbox illustrates how the various benefits of SLM may be assessed. Consideration is also given to the costs (implementation, transaction and opportunity costs) associated with modifying current land-use practices to be more sustainable.

Any comprehensive DLDD cost-benefit analysis (CBA) should account for both benefits and costs of halting land degradation. CBA is a powerful tool to help decision makers objectively choose among different land-use management strategies and thereby pursue effective, resilience-building interventions when funding is limited. More broadly, the resilience of any nation, community or smallholder can be strengthened through investment into the natural, political, financial, human or physical capital of the system under consideration. Striving towards a land degradation neutral world – whereby land degradation is avoided by sustainably managing land or offset through land restoration – promoted by a set of regulatory and economic instruments is key to resilience building.

Economic instruments for scaling up SLM hinge on the idea that those entities that provide benefits by lowering, for instance, off-site impacts of land degradation, should be compensated for their efforts, while those that engender land degradation or damage soil productivity must pay in accordance with the costs they inflict. Regulatory approaches typically serve to build capacity for implementing SLM and enable reforms that address tenure security and imperfect capital markets. On a global basis, investments in SLM are currently dwarfed by the flow of finance to activities that cause unsustainable land degradation. The corporate and financial sector therefore has an important role in generating finance for SLM on the one hand, and lessening the environmental impact of their supply chain on the other.

A broader perspective is taken in the latter part of the background paper, which exemplifies the interlinkages and synergies of three Rio conventions. In particular, it argues that there is significant scope for mainstreaming the use of economic instruments to tackle biodiversity loss, poverty alleviation, land degradation, and climate change mitigation and adaptation. This, however, is contingent upon the rigorous monitoring of and baseline-setting for harmonized biophysical and socioeconomic indicators. Significant advances have already been made in this respect. The paper concludes by showing how these advances can help scale up economic assessments and national green accounting to improve decision-making and create effective instruments to change the very incentives that guide how we manage our lands.

1. Introduction

DLDD present challenges for a growing number of people across climate zones, but most particularly in arid, semi-arid and dry sub-humid areas. The United Nations Convention to Combat Desertification (UNCCD) refers to these as 'drylands'. Given the extremely slow pace of soil formation, once the physical, biological and chemical properties of soils begin to deteriorate, their natural regeneration rate is practically unattainable (UNCCD 2012c). Hence, emerging and ongoing environmental and socioeconomic problems call for improving current land management practices that are grounded in sound scientific input. However, there is widespread consensus that the economic aspects of DLDD are not adequately addressed by the current political agenda. Unregulated markets also fail to respond: although the prices for agricultural land are increasing, investments to prevent degradation are lagging.

The UNCCD provides a legislative framework for DLDD, particularly in the drylands where some of the most vulnerable ecosystems and lower income groups in the world exist. The Convention's 195 Parties work together to improve the living conditions for people in drylands, maintain and restore land and soil productivity, and mitigate the effects of drought (UNCCD 2012a).

At its eighth session, the Conference of the Parties (COP) decided to strengthen the scientific basis underpinning the Convention. To this end, by its decision 13/COP.8, Parties decided that each future ordinary session of the Committee on Science and Technology (CST) should be organized in a predominantly scientific and technical conference-style format by the CST Bureau in consultation with a lead qualified institution/consortium that has expertise in the relevant thematic topic selected by the COP. The Global Risk Forum (GRF Davos) was selected as a lead institution by the CST Bureau to organize the UNCCD 2nd Scientific Conference under the guidance of the CST Bureau.

By its decision 16/COP.9, the COP decided that the specific thematic topic for the UNCCD 2nd Scientific Conference would be "Economic assessment of desertification, sustainable land management and resilience of arid, semi-arid and dry sub-humid areas."[1]

There is widespread consensus that economic issues related to DLDD are not adequately addressed in the current political agenda, and the lack of reliable data on the economic importance of sustainable dryland development is a major driver for the limited development investment in drylands. The lack of reliable economic data for sound and well-informed decision-making at all levels has been linked to the relatively limited scientific basis for the economic valuation of dryland ecosystems. Meanwhile, emerging and ongoing environmental and socioeconomic problems call for improving current land management practices based on sound scientific input.

The Scientific Advisory Committee (SAC) was established by the CST Bureau to guide the substantive preparation of the conference.[2] Under the leadership of the SAC, two working groups drafted two white papers: White Paper I on the economic and social impacts of DLDD and White Paper II on the costs and benefits of policies and practices addressing DLDD. The objectives of the white papers are to: (1) identify and assess the different types of costs related to DLDD and develop methodologies on how to develop effective policies and strategies, including support to shape action at local level; (2) synthesize existing scientific knowledge to present a basis for policy-oriented recommendations; and

[1] ICCD/COP(9)/18, http://www.unccd.int/Lists/OfficialDocuments/cop9/18add1eng.pdf
[2] ICCD/COP(10)/CST/5, http://www.unccd.int/Lists/OfficialDocuments/cop10/cst5eng.pdf

(3) ensure the flow of new knowledge to and from the UNCCD 2nd Scientific Conference. Further information on the conference can be found in the official UNCCD 2nd Scientific Conference website.[3]

The summary of the two white papers can be found in the official document of the third special session of the CST.[4] This background document is based on White Paper I and II but is a stand-alone, critical-synthesis document focussing on "The economics of desertification, land degradation and drought: methodologies and analysis for decision making."

This background document is structured in the following way. Chapter 2 presents estimates from different parts of the world on the costs incurred through DLDD, or conversely, the benefits of SLM. The chapter also introduces a toolbox that links the most pressing impacts of land degradation with possible economic valuation methods. Chapter 3 outlines a resilience framework that can help in conceptualizing potential resilience-building activities by strengthening the natural, social, financial, human or physical capital base of the system under consideration. It argues that SLM is a particularly important resilience-building activity that can help break the downward spiral of desertification and land degradation. Chapter 4 considers ways in which economic instruments and other complementary interventions may be used to induce greater take-up of SLM practices and ecosystem restoration. Given the deep interlinkages and synergies among the causes, issues and responses embedded in the three Rio conventions, chapter 5 calls for joint efforts in mainstreaming the use of economic instruments to alleviate poverty and tackle biodiversity loss, land degradation, and climate change mitigation and adaptation. This, however, hinges first of all on improved knowledge management and greater collaboration among the Rio conventions. Finally, chapter 6 demonstrates why knowledge management – chiefly, the rigorous monitoring of and baseline-setting for biophysical and socioeconomic indicators – is the key to mainstreaming cost-benefit analysis and national green accounting for better decision-making.

[3] http://2sc.unccd.int.

[4] ICCD/CST(S-3)/3, http://www.unccd.int/Lists/OfficialDocuments/CSTS-3/3eng.pdf.

2. ECONOMIC AND SOCIAL IMPACTS OF DESERTIFICATION, LAND DEGRADATION AND DROUGHT

This chapter reviews existing evidence of the societal impacts associated with DLDD and how to estimate in monetary terms the on-site, off-site, direct and indirect costs associated with DLDD. A valuation toolbox demonstrates how these impacts can be measured using different economic valuation methods. The basis for undertaking the cost-benefit analysis of continued degradation versus tackling land degradation through ecosystem restoration and SLM is outlined.

2.1. DEFINING THE PROBLEM

DLDD is interlinked and interrelated. Land degradation reduces the productivity of land, and, particularly in drylands, can leave the soil exposed and vulnerable to climatic hazards such as drought. The latest estimates indicate that 12 million hectares of land are transformed into new man-made deserts every year (UNCCD, 2011a) and that one quarter of the world's agricultural land is highly degraded – some irreversibly (FAO, 2011a). Degradation of land resources is manifested in desertification, soil erosion, secondary salinization and waterlogging, to mention a few, and affects one out of three people on Earth in at least way (FAO 2011b; Von Braun et al., 2012). Some areas are hit worse than others. In Africa, for instance, up to two thirds of productive land area is affected by land degradation.[5]

Desertification, land degradation and drought, whether driven by human actions, biophysical factors or a combination thereof, result in loss of or damage to natural capital and social welfare. Land degradation reduces the value of soil, water, plant and animal resources to society, including the contributions of ecosystem function and processes to primary production and related industries. It also reduces the quality of ecosystem services and the levels of biodiversity in natural and transformed systems.

The Rio+20 outcome document 'The Future We Want' recognizes "the importance of the three Rio conventions to advancing sustainable development" and "urges all Parties to fully implement their commitments" under the Conventions "in those countries experiencing serious drought and/or desertification" in accordance with their respective principles and provisions.

However, coordinated and accountable action by all Parties to halt land degradation requires the identification of measurable outcomes. A barrier to 'measuring progress' is the lack of globally and regionally harmonized definitions (involving both qualitative and quantitative parameters) in identifying degraded areas, i.e. establishing a baseline. Secondly, the existence of many different definitions of degraded lands and related terms,[6] ranging across ecosystems and national land jurisdictions, does not facilitate this task (IUCN 2012; Vogt et al., 2011). Two widely embraced definitions of land degradation are as follows:

Article 1 of the Convention defines land degradation as a "reduction or loss in arid, semi-arid, and dry sub-humid areas, of the biological or economic productivity and complexity of rain-fed cropland, irrigated cropland, or range, pasture, forest, and woodlands resulting from land uses or from a process or combination of processes, including processes arising from human activities and

[5] http://www.terrafrica.org/about/land-degradation/

[6] 'Degraded land' refers to biophysical dimensions, whereas 'marginal land' concerns socio-economic dimensions. Related terms include 'idle', 'abandoned', 'waste', 'unused', and 'underutilised' land.

habitation patterns, such as: (i) soil erosion caused by wind and/or water; (ii) deterioration of the physical, chemical, and biological or economic properties of soil; and (iii) long-term loss of natural vegetation." Desertification is a subset of land degradation under dry climates (arid, semi-arid, and dry sub-humid areas).

The Global Environment Facility (GEF) defines land degradation as: "Any form of deterioration of the natural potential of land that affects ecosystem integrity either in terms of reducing its sustainable ecological productivity or in terms of its native biological richness and maintenance of resilience."

These definitions make clear that land degradation is best viewed as a process, which may be caused by human or natural actions, or both. This implies that the identification of areas affected by land degradation requires time series data rather than static data sets. Fortunately, rapid technological development and satellite imagery have supported the provision of time series data, for example on vegetation land cover using the normalized difference vegetation index (NDVI).

This paper emphasizes the market and non-market implications of changes in ecosystem services resulting from changing land-use practices. However, despite recent advances in monitoring biophysical and socioeconomic impacts, there are still strong data and capacity constraints to scaling up and ensuring coherent and consistent valuations across all dryland ecosystems. This paper – by making a clear case for how to improve decision-making tools using economic tools – may fuel progress towards scaling up efforts, from better measurement and monitoring to evaluation, scenario-building and policy advice.

2.1.1. Proximate and underlying causes of land degradation

Land degradation and desertification have accelerated during the twentieth century due to an increasing number of causes as well as their combined effects. Following Geist and Lambin (2004), these causes fit into two categories: proximate and underlying. Proximate causes are those that have a direct effect on the terrestrial ecosystem. These are related to climate conditions and extreme weather events such as droughts and coastal surges, which may, for example, cause land to become saline (biophysical). Proximate causes are also related to unsustainable land management practices (anthropogenic) such as over-cultivation, overgrazing and excessive forest conversion. The underlying causes are those that indirectly affect proximate causes, for example a lack of institutions to enact regulations or bylaws that could enhance SLM practices (FAO 2011). Poverty or insecure land tenure may also underlie desertification and land degradation by hampering incentives or means of land users to invest in sustainable land management practices (Kabubo-Mariara 2007). Chapter 2.2 reviews some of the major impacts and costs associated with DLDD and the failure to tackle DLDD. The chapter then introduces a toolbox on valuation methods that can be used to estimate these impacts in monetary terms. This toolbox will ultimately be used to help decision-makers undertake land-use planning and consider relevant trade-offs between possible land uses.

2.2. MEASURING THE PROBLEM

2.2.1. Direct costs of desertification, land degradation and drought

2.2.1.1. Desertification and land degradation

Desertification and land degradation are considerably limiting land productivity and its ability to provide ecosystem services at local, national and regional scales. The loss of ecosystem services is manifested through decreases in soil fertility, carbon sequestration capacity, wood production, groundwater recharge, grazing and hunting opportunities, and tourism – all factors that directly impact the economies touched by land degradation.

However, most studies have focused on loss of on-site productivity as a percentage of agricultural gross domestic product (GDP). These studies give estimates of annual economic losses in the range of 1–10 per cent of agricultural gross domestic product for various countries. Direct costs are associated with soil nutrient loss, which includes losses of nitrogen, phosphorus, potassium, and organic matter (largely due to soil erosion by wind), as well as agricultural output loss (linked to crop farming and animal husbandry). Agricultural income is also impacted by increases in production costs resulting from the need to apply more inputs to address the negative biophysical impacts of land degradation (Von Braun et al., 2012). The following examples provide a brief and global insight into some previous findings.

In China, over 400 million residents are affected by desertification, causing an annual direct economic loss that exceeds USD 10 billion (Wang et al., 2012). In India, losses due to erosion have increased by a factor of six between 1989 and 1994 (Reddy 2003). In a comprehensive study on the impacts of DLDD in Ghana, Diao and Sarpong (2007) estimated the effects of soil loss on the economy using a computable general equilibrium model. The model predicted that land degradation will have reduced agricultural income in Ghana by USD 4.2 billion over the period 2006–2015, approximately 5 per cent of the total agricultural GDP in the same period. For the entire African continent, it has been estimated that 4–12 per cent of the GDP is lost due to environmental degradation, with 85 per cent resulting from soil erosion, nutrient loss and changes in crops (Olsen and Barry, 2003). In Latin America, losses in agricultural GDP associated with land degradation vary widely between and within countries, reaching values at least of 6.6 per cent in Paraguay and 24 per cent in Guatemala (Morales, Dascal, Aranibar Morera, 2012). Globally, these direct costs are far from negligible. A study commissioned by the Global Mechanism (GM) estimated that the global costs of land degradation correspond to 3–5 per cent of the global agricultural GDP (Berry *et al*., 2003).

2.2.1.2. Impacts of climate change and droughts

The direct impacts of drought are also increasingly visible. Since the 1960s, sown areas for all major crops have increasingly experienced drought. Drought-affected areas for maize more than doubled from 8.5 per cent to 18.6 per cent (Li, Ye, Wang, and Yan 2009). Drought conditions associated with the Russian heat wave in 2010 caused grain harvest losses of 25 per cent, leading the Russian Government to ban wheat exports, and about USD 15 billion (about 1 per cent gross domestic product) of total economic loss (Barriopedro et al., 2011). Recent work has begun linking global warming to recent record-breaking droughts and heat waves. Table 1 shows a number of recent unusual events; there is now substantial scientific evidence linking them to global warming with medium to high levels of confidence (World Bank 2012).

TABLE 1: SELECTION OF RECORD-BREAKING METEOROLOGICAL EVENTS SINCE 2000 AND THEIR SOCIETAL IMPACTS (EXTRACTED FROM: WORLD BANK 2012 – TURN DOWN THE HEAT, WHY A 4°C WARMER WORLD MUST BE AVOIDED)

Where	What	Impacts/costs
Western Amazon (2010)	Drought, record low water level in Rio Negro[7]	Area with significantly increased tree mortality spanning 3.2 million square kilometers[7]
Western Europe (2011)	Hottest and driest spring on record in France since 1880[8]	French grain harvest down by 12 per cent
United States of America (Texas, Oklahoma, New Mexico, Louisiana) (2011)	Record-breaking summer heat and drought since 1880[9] [10]	Wildfires burning 3 million acres / preliminary impact of USD 6 to 8 billion[11]
Continental United States of America (2012)	July warmest month on record since 1895 and severe drought conditions[12]	Abrupt global food price increase due to crop losses[13]
Western Russia (2010)	Hottest summer since 1501[14]	500 wildfires around Moscow, crop failure of ca. 25 per cent, death toll ca. 55,000 / economic losses ca. USD 15 billion[10]

2.2.1.3. Distributional implications

It is often the poorest and most vulnerable households in developing countries that are most affected by the impacts of DLDD. This is largely because their livelihoods are closely linked to the natural resource base. At global level there is a positive correlation between poverty and land degradation. About 42 per cent of the poor around the world depend on degraded and marginal areas for their livelihoods, compared with 32 per cent of the moderately poor and 15 per cent of the non-poor (Nachtergaele et al., 2010). The poor are not only affected by the direct costs linked to 'dependence' on degraded land. Once land degradation has occurred, it generates negative feedback loops influencing wider natural processes (Von Braun et al., 2012). Off-site effects and induced indirect costs of DLDD are discussed in the following sections.

2.2.2. Off-site costs of desertification, land degradation and drought

Lack of action to tackle the causes of land degradation has been attributed to the fact that it involves significant off-site costs not experienced in full by those responsible for the degradation (Hayes, 1997). Off-site impacts of DLDD include dust storms, dryland salinity, changes in stream flow, reliability of irrigation water flow, decline in the quality of drinking water, and the silting of rivers, lakes, reefs systems and dams, etc.

[7] Simon L. Lewis, Paulo M. Brando, Oliver L. Phillips et al., The 2010 Amazon Drought, Science, 331-554 (2011).
[8] WMO, http://www.wmo.int/pages/mediacentre/press_releases/gcs_2011_en.html (2011).
[9] NOAA, http://www.ncdc.noaa.gov/sotc/national/2011/8 (published online September 2011).
[10] D.E. Rupp, P.W. Mote, N. Massey et al., Did Human influence on climate make the 2011 Texas drought more probable? BAMS, 1053 (2012).
[11] NOAA, http://www.ncdc.noaa.gov/sotc/hazards/2011/8 (published online September 2011).
[12] NOAA, http://www.ncdc.noaa.gov/sotc/national/2012/7 (published online Aug 2012) (2012).
[13] World-Bank, Press release (available: http://www.worldbank.org/en/news/2012/08/30/severe-droughts-drive-food-prices-higher-threatening-poor) (2012).
[14] D. Barriopedro, E.M. Fischer, J Luterbacher et al., The hot summer of 2010: redrawing the temperature record map of Europe. 332 (6026), 220 (2011).

With respect to the latter, the deposition of eroded soils in reservoirs reduces reservoir water storage capacity, leads to equipment damage, reduces the effectiveness of flood control structures, disrupts stream ecology, decreases navigability of waterways and harbours, increases maintenance costs of dams, and shortens the lifetime of reservoirs. The indirect costs can be significant. In Kenya, the estimated cost of dam siltation was about USD 127 million, or about USD 1,000 per square kilometre of the watershed area in 2008 (Nkonya et al. 2008). Globally the cost of the siltation of water reservoirs has been estimated at about USD 18.5 billion (Basson 2010). However, the off-site effects of soil erosion include the deposition of alluvial soils in the valley plains, which form fertile soils and higher land productivity (Pimentel 2006).

Dryland salinity has also been framed as a problem involving off-site impacts. One farmer's management (or non-management) of salinity has impacts on neighbouring farms, natural ecosystems, rural towns, water resources, roads and other infrastructure through movements of saline groundwater and/or saline discharge into waterways. In economic terms, off-site impacts from DLDD are seen as problems of market failure due to externalities, including external costs from one farmer to another and from the farm sector to the non-farm sector (Pannell et al*.* 2001). Salinity in global agriculture has been estimated to cost about USD 12 billion per year (Pitman and Läuchli 2004).

2.2.3. *Indirect costs of desertification, land degradation and drought*

The combined consequences of DLDD are significant. For instance, a lower supply of agricultural products leads to increases in food prices, which has significant knock-on effects on rural poverty, food insecurity, and malnutrition. Potential impacts of desertification and drought on health include:[15] higher threats of malnutrition from reduced food and water supplies; more water- and food-borne diseases that result from poor hygiene and a lack of clean water; respiratory diseases caused by atmospheric dust from wind erosion and other air pollutants; and the spread of infectious diseases as populations migrate.

According to the United Nations Hunger Report (FAO 2012), nearly 870 million people, or one in eight, have been suffering from chronic undernourishment between 2010–2012. Approx. 1.1 billion people do not have access to safe drinking water. The highest Global Hunger Index (GHI) scores are found in Burundi, Eritrea, Haiti, Ethiopia, Chad and Timor-Leste (IFPRI et al., 2012) – countries associated with a high incidence of DLDD. Using a bio-economic model, Holden and Shiferaw (2004) analysed the combined effects of land degradation, population growth, market imperfections and increased risk of drought on household production, welfare and food security. They found that the indirect effects of drought on household welfare through impacts on crop and livestock prices are larger than the direct effects of drought on production.

Desertification and drought may also have repercussions on social issues and conflicts such as forced migration, public unrest, or conflicts over natural resources (Requier-Desjardins et al., 2011). Increasing scarcity of land has led to a surge in land investments as demonstrated by the largest public database on land deals (http://landportal.info/landmatrix). There is currently little or no regulation of these land deals. Concerns have been expressed that customary rights to land access and use are often not adequately compensated in land deals (Quiellérou and Thomas 2012).

[15] http://www.who.int/globalchange/ecosystems/desert/en/index.html.

By reducing the provision of global ecosystem services such as carbon sequestration, DLDD also impacts current climate change mitigation efforts (Lal 2004). Recent analysis indicates that increasing global warming could lead to extreme events occurring more frequently in a globally synchronized way (Petoukhov, et al., in review). This could significantly reduce our resilience to risks at a global scale. For instance, if three large areas of the world are simultaneously being adversely affected by drought, there is a growing risk that global agricultural production may not be able to compensate for regional droughts as it has in the past (Dai 2012). Moreover, in a recent analysis of historical data for the period 1950 to 2003, Dell et al., (2009) show that the effects of warmer temperatures and droughts on economic growth are felt throughout the economies of poor countries and persist over 15-year time horizons. While not conclusive, this study suggests a risk of reduced economic growth rates in poor countries in the future unless significant efforts are undertaken to adapt to and mitigate climate change (World Bank 2012).

2.3. COST-BENEFIT ANALYSIS

While sound information is available on natural resource losses due to land and soil degradation, this has not been sufficient to foster policy action. Moreover, estimating the costs of land degradation, no matter how well done, will only bring us a little closer to deciding what to do about it (Yesuf et al., 2005). Rather, systematic comparisons of all costs and benefits of alternative land use practices is what leads decision-makers to informed choices about how and if to tackle the causes and impacts of DLDD.

More precisely, decision-makers can take action to control the causes of land degradation, its level or the effects of land degradation. The level of land degradation determines its effects – whether on-site or off-site – on the provision of ecosystem services and the benefits humans derive from those services. Many of the services provided by healthy ecosystems are not traded in the market and therefore have no explicit price. Hence, as the benefits of sustainable land management, as opposed to unsustainable, are 'external' to the land user, they are generally not considered in the user's decision-making over land use. This leads to the undervaluation of land and its provision of ecosystem services. Cost-benefit analysis attributes monetary values to non-market goods and services, thereby putting them on a par with marketed goods. Cost-benefit analysis is therefore an effective means to help decision-makers compensate for information deficiencies.

2.3.1. A toolbox for conducting a cost-benefit analysis

If the baseline scenario is continued land degradation, the total economic benefits of ecosystem restoration, or the employment of SLM practices, correspond to the avoided costs associated with land degradation (Quillérou and Thomas 2012). The avoided costs can be estimated using a range of methods (outlined below and in the toolbox titled 'Measuring costs of DLDD'). The toolbox highlights the proximate and underlying causes of DLDD, the potential impacts of DLDD, whether they are direct, indirect, on- or off-site, and how these impacts may be translated into the costs of failing to tackle DLDD. The costs of failing to tackle land degradation are used in a CBA to indicate the benefits of halting land degradation. Like benefits, costs have their own classification system that helps to keep track of expenditures associated with new sustainable land-use practices. These are explained below.

In measuring whether a land use intervention is socially desirable, or how to prioritise between different land use projects, all future discounted costs are subtracted from all future discounted benefits of each project to yield a net present value (NPV). Alternatively, one may estimate the internal rate of return (IRR) of an investment, which is the interest rate at which the NPV of the costs equals the NPV of the benefits of the investment. The higher a project's rate of return, the more desirable it is to undertake the project.

In several case studies, authors have attempted to estimate the costs of action versus the costs of inaction. Morales et al. (2012) calculated the annual cost of inaction in terms of total productive factor and gross value product as a proportion of agricultural GDP, estimating values between 7.6 per cent and 40.5 per cent per annum. In Nkonya et al., 2011, the cost of action (in terms of prevention) was lower than the cost of inaction for seven out of eight case studies, even when the costs of degradation are defined only in terms of decreased crop yields. For instance, in India about 2 per cent of crop area was affected by salinity, which reduced crop rice yields by as much as 22 per cent. Based on crop simulation models, the cost of desalinization was estimated at only 60 per cent of the costs of inaction. The consistent net-benefit estimates of 'action over inaction' suggests the need to explore the underlying reasons for why action against land degradation is not being adopted on a large scale (Nkonya et al., 2011).

Box 1: Cost of action versus inaction

2.3.2. Ecosystem service benefits associated with avoided land degradation

To help identify the cost and benefits associated with different land-use practices, it is useful to consider how different ecosystem goods and services are impacted. Ecosystem services have been categorized by the Millennium Ecosystem Assessment (MA 2005) as having provisioning (food, timber, freshwater, medicines, etc.), regulating (e.g. climate regulation through carbon storage and sequestration, water purification and regulation), cultural (aesthetic, spiritual and recreational value) and supporting (soil formation and nutrient cycling) functions. Since supporting services are processes underlying the provision of ecosystem services, they cannot be valued as such. Most work to determine the costs of DLDD focus on declines in the provisioning services of affected ecosystems, i.e. the direct costs of declining productivity in crop and/or livestock production systems. The full impact of DLDD on ecosystems, however, goes beyond provisioning services to affect important regulating and cultural services that should ideally be accounted for.

Provisioning services are typically valued by measuring productivity changes experienced by farmers onsite. The costs of land degradation are estimated using production functions that link levels of land degradation with agricultural yields (see e.g. Alfsen et al., 1996; Pimentel et al., 1995). Provisioning services can also be estimated using replacement or avoided costs spent by people to 'avert or replace' negative impacts of DLDD. Soil erosion, for instance, will lead to a loss of soil nutrients that can be compensated by an increased quantity of fertiliser (Stoorvogel 1990). Finally, provisioning services or **cultural ecosystem services** such as tourism can also be estimated by constructing a hypothetical market in a stated preference study. Stated preference methods – such as choice experiments or contingent valuation – attempt to elicit willingness to pay (WTP) for an environmental improvement or willingness to accept (WTA) compensation for environmental degradation for a representative sample of the affected population. The methods identified for valuing health effects from dust storms to malnutrition range from sophisticated calculations of disability-adjusted life years (DALYs) and value of statistical life (VSL) to calculations of costs of illness including lost workdays and medical expenses (WHO 2009). **Regulating services** such as soil nutrient runoff reduction and soil carbon sequestration may be valued by estimating the quantity of carbon sequestered or nutrient retained and multiplying it by the market price for carbon and nutrients, provided that the analyst can estimate reliable biophysical cause-effects models (i.e. how changes in land-use management affects regulating services). These cause-effects models can be calibrated in open-source software such as InVest and ARIES. For further information about how to actually conduct the different valuation methods, refer to TEEB (2010) and appendix 1.

2.4. Transaction, implementation and opportunity costs associated with avoiding land degradation

2.4.1. *Opportunity costs*

Scaling up SLM or ecosystem restoration to halt or reverse land degradation comes at a cost. This is because land degradation associated with logging, overgrazing of animals, fuel wood collection, etc. also brings benefits. Avoiding land degradation implies foregoing some of these benefits, at least in the short run. The cost of foregone benefits is known as an ‘opportunity costs’. The estimation of opportunity costs is a central problem in payment for ecosystem services (PES) schemes (such as REDD+) and should be considered carefully in any comprehensive cost-benefit analysis of alternative land-use strategies. Estimating opportunity costs is also critical to understanding the causes of land degradation. Most economic agents do not cut degraded land out of malice—they do so because they expect to benefit from it. Estimating the magnitude of opportunity costs gives a fair estimate of the pressures leading to degradation and hence the types of interventions needed to reduce land degradation. Furthermore, understanding how opportunity costs are distributed across groups within society tells us who would gain and who would lose from new policies or projects (Pagiola and Bosquet 2009).

2.4.2. *Transaction costs*

Another cost associated with modifying resource management or land-use practices are transaction costs. For instance, project managers must find viable land that can be restored and then work with the land managers or owners to restore it. The negotiation process between the buyer and seller in the PES programme, or between donor and recipient, can be long and costly because negotiation processes may be complicated by land tenure discussions or technical concerns. Given the transboundary effects of land, water and other resource management costs and benefits, equitable regional arrangements will need to be considered. Transaction costs are separate from implementation costs, as they do not reduce land degradation by themselves.

2.4.3. *Implementation costs*

Costs involved in implementing sustainable land-use practices or land restoration are directly associated with these specific undertakings. These may involve costs for: planting trees to increase resource use efficiency in agroecosystems; building or installing water harvesting structures; protecting land in upper catchments so that land and water resources are not compromised by overgrazing or excess deforestation; sustainably intensifying agriculture or cattle ranching so that less forest land is necessary for food production; delineating and/or titling land to traditional and indigenous communities so that they have an incentive to protect forests against conversion; and so on (World Bank 2006; Pagiola and Bosquet 2009). All of these measures incur investment and recurring costs for the public and/or the private sectors, which should be assessed in a CBA analysis.

2.5. The appropriate temporal and spatial scales in cost-benefit analysis

CBA involves the valuation of marginal changes in a static framework. Non-marginal changes (e.g. associated with major simultaneous restoration initiatives or droughts) are likely to have an impact on regional or global food prices. In this case, existing (pre-restoration) prices cannot be used as a basis for valuing post-restoration consequences, which will be associated with a whole new set of prices. Moreover, since CBAs serve to identify the optimal course of action from a societal perspective within the geographical bounds of the decision-maker, global valuations can do little more than raise awareness (Bockstael et al., 2000).

Rather, CBA lends itself to defining cost-benefit ratios of any number of well-defined land-use scenarios. As shown in chapter 4, economic valuation is particularly useful as a means to design economic instruments that can send right price signals and correct for off-site costs of inappropriate land use practices. Because the incentives that face resource users are less likely to vary across a particular region, economic instruments are often more suited for implementation at the local or regional level (Rolfe and Mallawaarachchi 2007). As a result, CBAs should be conducted at corresponding spatial scales. It is also essential that the time horizon of the evaluated land-use changes are carefully considered. Adopting sustainable dryland management practices may be associated with upfront costs depending on the practice, while the benefits are relevant in the medium to long term. In this case, the chosen discount rate and temporal horizon of the CBA may significantly alter the benefit-cost ratio of adopting SLM practices.

2.5.1. Using the toolbox for informed decision-making

To decide whether it is optimal from a societal perspective to control the level of degradation (mitigation of causes), adjust to its effects (adaptation) or do nothing (inaction), the decision-maker would need to know the value of the ecosystem services affected by possible policy interventions.[16] As seen in the toolbox (table 2) 'inaction' is associated with the highest level of foregone benefits (enhanced agricultural production, better water quality and quantity, improved health, etc.). When opting for 'simply' controlling the effects of degradation, incurred costs relate to damage mitigation, higher input costs to replace nutrient loss and the value of increased labour time spent to collect water or timber. When either 'inaction' or 'adaptation' is considered by the decision-maker as opposed to controlling the causes, it is important that the foregone benefits from SLM are compared to the cost of tackling the causes and hence the level of degradation.

As shown in section 2.2.1 above, the causes of land degradation are numerous, interrelated and complex. The same causal factor could lead to different consequences in different contexts because of interactions with other proximate and underlying causes of land degradation. As explained in Braun et al., (2012), this implies that targeting one underlying factor is not in itself sufficient to address land degradation. Rather, a number of underlying and proximate factors need to be taken into account when designing policies to prevent or mitigate land degradation. In this context, there is a need to develop context-specific SLM packages that include relevant technological, policy and

[16] The toolbox does not provide a comprehensive picture of all the values affected by changes in ecosystem services. For instance, while cultural or religious aspects of wild resource use may be very important, there remain serious doubts about the meaningfulness of estimating the dollar value of, for example, religious or cultural views (Gray et al., 2005). Generally, the more we abstract from valuing 'tangible' goods such as commodities, the more unreliable our valuation exercises. This is exacerbated the larger and more complex the system is that is being valued. The quantitative values assigned through valuation studies are therefore bound to be an incomplete measure of the multidimensional sources of human welfare.

institutional factors which need to be implemented jointly to reduce land degradation in a way that maximizes the net benefits. This will be discussed in the next chapter. To end this section, we highlight some of the key reasons why economic valuation of land degradation, desertification and drought can be of great value.

2.6. CONCLUDING COMMENTS

In real terms, annual food price indices have doubled since 1990, making land more profitable.[17] Increasing land prices are a clear market signal of the urgency of addressing land degradation. However, high land prices have not been sufficient to trigger the necessary investments in land restoration or adopt SLM practices. Unless we account for the full value of land and healthy soils in land management practices, we are unlikely to change the status quo. Lack of information on the on-site and off-site costs of land degradation or, conversely, the benefits of SLM, hinders the identification of areas where investments would be most effective from a societal perspective. Exacerbating the problem of unaccounted externalities (off-site costs) are prevailing information asymmetries between governments and local stakeholders. Often, local stakeholders affected by land degradation do not have the necessary knowledge or means to make their case at the national level (Quillerou and Thomas 2012). Economic analysis may help better balance negotiating power between stakeholder groups by increasing transparency over the level of compensation to be provided. CBAs can demonstrate the full value of land to help both decision makers and land managers assess current and future land-use practices and enable the analysis of trade-offs associated with different land-use patterns.

[17] www.fao.org/worldfoodsituation/en/

TABLE 2: VALUATION TOOLBOX: THE COSTS OF LAND DEGRADATION (OR AVOIDED COSTS). (ADAPTED FROM WHITE PAPER 1)

Causes of desertification, land degradation and drought (Underlying (U)/proximate (P))	**Consequences**	**On-site/off-site**	**Impacts**	**Associated direct (D) and/or indirect costs (I)**	**Valuation methodology (examples; non exhaustive)**
Topography (P) Land cover (P) Climate (P) Soil erodability (P) Invasive alien species and pests (P) Unsustainable land management (P) Agricultural expansion (P) Wood extraction (P) Infrastructure development (P) Demographic factors (U) Institutions and land tenure (U) Agricultural production factors (U) Technological change (U) Access to agricultural extension services (U) Poverty (U) Decentralisation (U) Property rights (U) Formal policies (U)	Productivity of farming	On-site	Loss of agricultural yield	D	Production function-based approach
			Soil nutrient depletion due to erosion	D/I	Replacement costs of other inputs such as fertilisers
			Malnutrition	D	Disability-adjusted life years (DALYs), value of statistical life (VSL), cost of illness, cost of lost working days
			Salinity	D	Avoided cost of desalination
	Livestock farming/pastoralism	On-site	Loss of milk, meat and hides	D	Production function-based approach
	Water quantity and water quality	On-site/off-site	Flash floods	D	Avoided damage costs
			Declining fish populations	D/I	Production function-based approach
			Health	D/I	DALY, VSL, cost of illness, cost of lost working days
			Siltation of rivers and reservoirs	D/I	Replacement cost (cost of dredging reservoirs, least-costly alternative source of power) Avoided damage costs (increased water purification cost) Production function-based approach (loss in agricultural output resulting from reduced irrigation)
			Aquifer depletion	D	Replacement cost (increased pumping costs or drilling a deeper replacement pump) Opportunity cost of additional time spent to collect water
	Dust storms	On-site/off-site	Health	I	DALY, VSL, cost of illness, cost of lost working days
			Discomfort	D	Expenditure on aversive behaviour/damage mitigation
			Reduced labour productivity	D/I	Value of reduced output
	Biodiversity	On-site	Decrease in wild food availability	D	Opportunity cost of additional time spent 'gathering, hunting or fishing' Values of substitute goods
			Loss of emblematic species	D	Stated preference methods
			Loss of genetic resources	D	Stated preference methods
	Carbon sequestration	On-site	Reduced climate mitigation	D	Carbon market prices, social cost of carbon
	Ecotourism and recreation	On-site	Decrease in visitor numbers	D	Stated preference Travel cost Hedonic pricing (hotels)

3. Resilience and sustainable land management

Mitigation of or adaptation to land degradation, desertification and drought requires management for resilience. This chapter presents a resilience framework so as to provide a better foundation for understanding the many factors or interventions that can help foster resilient dryland and drought risk management. In this light, the chapter presents the case for a zero net land degradation (ZNLD) target. This target embodies SLM and the restoration of degraded ecosystems. The enabling factors that help scale-up these activities are outlined.

3.1. Resilience framework for dryland and drought risk management

A major challenge of managing ecosystems is their non-linear nature. Ecosystems that might seem healthy and functional with an unchanged provision of services might change suddenly when critical thresholds for handling internal and external stressors are reached (Schroll et al*.,* 2009). Moreover, social-ecological systems are often exposed to multiple underlying and proximate stressors that interact in unpredictable ways. Sustainable dryland and drought risk management thus requires management for resilience.

Current efforts using a traditional sectoral approach to manage causes and impacts of DLDD are often incomplete. These include the manipulation of individual resources (e.g. soil, forest) with insufficient capacity to implement synergetic actions at decentralized level. Specific problem-oriented methodologies and guidelines for decision makers are rare (e.g. Bowyer et al., 2009). Moreover, at national level, only a few UNCCD Parties have satisfactory legislation to combat desertification, land degradation and mitigate the effects of drought, meaning that substantial reform is essential (Du Qun and Hannam, 2011).

Resilience theory may be used to guide such reform. Resilience theory is the focus of a large and growing body of research. This work has sought to understand what the properties are that make a country, community or household resilient and able to withstand and recover from shocks and stresses such as DLDD (DFID 2011). Three widely cited definitions for resilience are:

"The ability of a system, community or society exposed to hazards to resist, absorb, accommodate to and recover from the effects of a hazard in a timely and efficient manner" (UNISDR, 2009.[18]

"The ability of a social or ecological system to absorb disturbances while retaining the same basic structure and ways of functioning, the capacity for self-organization, and the capacity to adapt to stress and change." (IPCC, 2007)

"The capacity to tolerate disturbance without collapsing into a qualitatively different state that is controlled by a different set of processes." (The Resilience Alliance[19])

More specifically, with respect to land degradation and drought risk management, the objective of resilience management is to ensure the continuation of dryland functions, reduce the costs of

[18] http://preventionweb.net/go/501.

[19] The Resilience Alliance is an international network of scientists with roots mainly in ecology and ecological economics working towards greater insight into the function of social-ecological systems and the policy process of sustainable development. resalliance.org/.

disruption and facilitate a structured return following impact stressors such as climate stress. This is consistent with recent research, which highlights that resilience is a dynamic process that is part of the development process leading to sustainability (Mäler and Chuan-Zhong, 2010).

The above definitions share four common elements with most other definitions of resilience. These are the 'system' (resilience of what), 'disturbance' (resilience to what), 'capacity to deal with disturbance' and 'reaction to disturbance'. Together, these elements may form a resilience framework that can be used to determine different kinds and levels of resilience in drylands. A 'simplified' resilience framework is provided below, borrowing the 'five capitals' approach from the sustainable livelihoods framework (DFID, 1999).

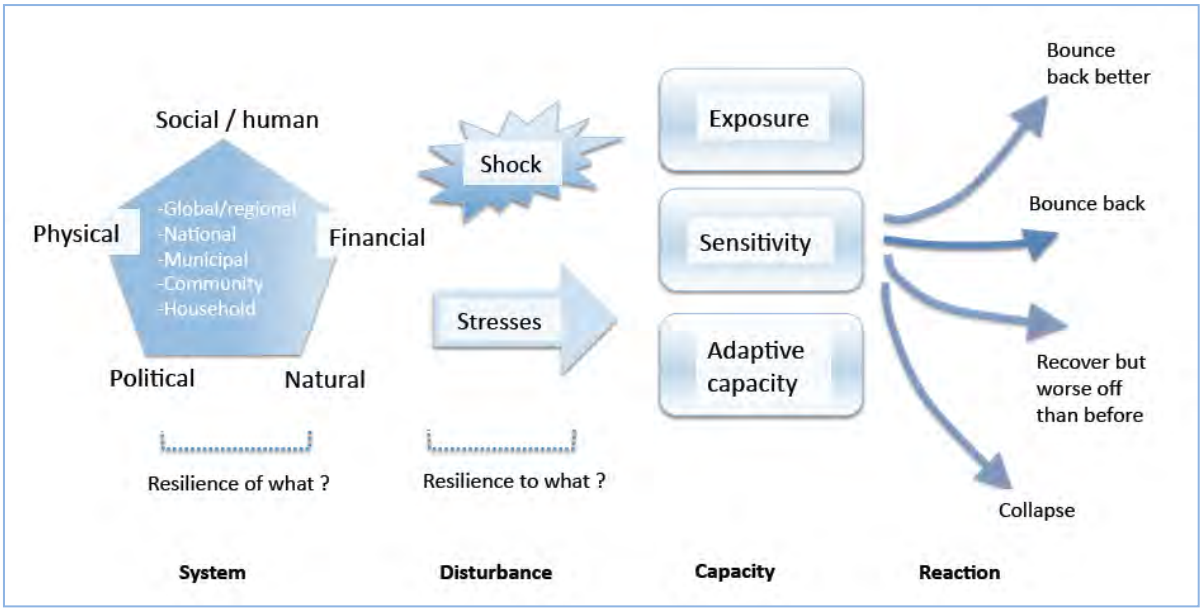

FIGURE 1: RESILIENCE FRAMEWORK ADAPTED (WITH SMALL MODIFICATIONS FROM DFID, 2011)

Within this framework, 'system' has to do with who or what is under consideration – a social group (e.g. a community), a political system or a particular environmental context. The next stage consists of understanding the disturbances faced by addressing the question 'resilience to what?' (DFID 2011). These disturbances usually take two forms in the context of drylands. A drought – or shock – may be characterised as a sudden event that impacts the vulnerability of the system. Land degradation and desertification, on the other hand, refer to longer-term trends – or stresses – that undermine the potential of a given system and increase the vulnerability of the actors within it. Countries or regions often face multiple interconnected shocks and stresses, such as a severe drought coupled with political instability.

3.1.1. Examples of how disturbances are dealt with in drylands

The ability of a system or process to deal with DDLD is based on the level of exposure, sensitivity, and adaptive capacities. The 'exposure' to risk is a measure of the magnitude of the stress or the shock, for instance the length and the frequency of droughts within a certain region. The 'sensitivity' of the system determines the degree to which a system will be affected by or respond to a certain shock or stress. This can vary between the actors of the system. Limited mobility, skill set and social status, have shown to exacerbate sensitivity to shocks (Miller et al., 2006; DFID, 2011). 'Adaptive capacities' refer to the ability of actors to adjust to and learn from shocks or stresses (Norris et al., 2008).

In line with the sustainable livelihoods approach (DFID 1999), sensitivity and adaptive capacities may be determined by the pool of assets and resources that can be mobilized in the face of shocks and stresses (Mayunga, 2007). These can be human, physical, natural, financial or social. Each of these five capitals corresponds to a number of characteristics of resilient systems. For example, a strong base of social capital in the form of trust, norms and networks would lead to a high degree of coordination and cooperation in the community. Similarly, human capital in the form of education, health, skills, knowledge and information will lead to, for instance, a high capacity to develop and implement an effective risk reduction strategy (Osbahr et al., 2008).

The ‘five capitals’ approach acknowledges the interconnection of human and ecological systems by stating that both natural capital and social capital, in addition to political, financial and physical capital, have a role in determining the resilience of a system (Mayunga, 2007). For instance, several authors have commented that losses are often compensated by social resilience in the early stages of land degradation and desertification (Bollig and Schulte, 1999; Pamo, 1998; Reynolds et al., 2007) or by economic inputs from government (Vogel and Smith, 2002). However, when certain thresholds are crossed, social resilience or government subsidies may not be enough to compensate for the loss of productivity. This leads to a number of changes such as fluctuations in prices and trade or population migration, which undermine the capacity of the system to bounce back to the pre-existing condition (Reynolds et al., 2007).

In northern Cameroon, nomadic livestock systems were relatively well adapted to the fluctuating sub-Sahelian environment of the region until 1979 when the Maga Dam was built to store water for a rice irrigation project. The dam prevented the normal flooding of dry season grazing land for livestock and wildlife and induced large-scale desertification. Pamo (1998) argued that wildlife and pastoralists in the region adjusted to the new conditions by diversifying their herds and practicing increased mobility.

In the villages of Rissiam and Ranawa in the northern part of the Central Plateau of Burkina Faso, all wells used to dry up as soon as the rainy season stopped. After following the introduction of water-harvesting techniques that force rainfall and runoff to infiltrate the soil in these villages in the early 1980s, all water points in these villages have water during the entire year. Despite the fact that the population of Ranawa has more than doubled since 1985, more water is available for crops, people and livestock.[20]

Others have commented on the success stories and the remarkable resilience and adaptability of the people who inhabit the African drylands. As contributing factors, Reij and Steeds (2003) noted the positive role of innovators; public support for private investment in soil and water conservation; sound macroeconomic management that does not discriminate against agricultural and natural resources; robust local capacity-building by non-governmental organizations and other cooperative-type projects; and consistent efforts by concerned governments to increase awareness of environmental problems and possible solutions.

The examples show that – depending on the system, disturbances and adaptive capacities – the reaction to shocks or stresses may take different shapes. As illustrated in the resilience framework, in rather rudimentary terms, the reaction to the shock or stresses might be “bounce back better”, “bounce back to a normal pre-existing condition”, or “recover but worse than before” (DFID, 2011). So far, few attempts have been made to value policies and practices aiming at strengthening

[20] http://www.unccd.int/en/programmes/Thematic-Priorities/Food-Sec/Pages/FS-SLM.aspx

resilience of dryland communities. For example, Mäler & Chuan-Zhong (2010) note that while many recent papers dealing with the valuation of ecosystem services include some thoughts about resilience, resilience has generally not been considered as having genuine economic value.

3.2. RESILIENCE-BUILDING INTERVENTIONS – THE CASE FOR SUSTAINABLE LAND AND FOREST MANAGEMENT

At the United Nations Conference on Sustainable Development (Rio+20) held in June 2012, the UNCCD proposed a new ambitious target aimed at achieving a land degradation neutral world by 2030 (UNCSD, 2012). With reference to the resilience framework, zero net land degradation (ZNLD) can be achieved by scaling up sustainable forest and land management to avoid the degradation of natural capital, or by offsetting land degradation through land restoration (Davies et al., 2012; Gnacadja, 2012; GCP, 2012).

SLM can be defined as:

"The use of land resources, including soils, water, animals and plants, for the production of goods to meet changing human needs, while simultaneously ensuring the long-term productive potential of these resources and the maintenance of their environmental functions." (UN Earth Summit, 1992)

"A knowledge-based procedure that helps to integrate land, water, biodiversity, and environmental management to meet rising food and fibre demands while sustaining ecosystem services and livelihoods." (World Bank, 2006)

"Land managed in such a way as to maintain or improve ecosystems services for human well-being, as negotiated for all stakeholders." (UNCCD, 2009b)

One of the most important aspects of SLM is the critical merging of agriculture and environment through the twin objectives of maintaining regulating ecosystem services and increasing productivity and diversity of goods and services (Terrafrica, 2008; Woodfine, 2009). To achieve these twin objectives, SLM should be implemented across the wide dryland production landscapes. This involves:

- Basing SLM practices on agro-ecological principles, whereby complementary benefits of species (trees and crops) and systems (farming and livestock keeping) limit the use of mineral fertilisers, irrigation or mechanization, reducing dependency on energy and expensive inputs;[21] and
- Undertaking actions to stop and reverse degradation – or at least to mitigate the adverse effects of earlier misuse – especially where the consequences of upland degradation are being felt in far more densely populated areas 'downstream'(World Bank. 2006).

The latter point also reflects the importance of sustainable forest management (SFM) in upland areas. UNCCD decision 4/COP.8 calls for the reinforcement of SFM as a means of preventing soil erosion and flooding, thus increasing the size of atmospheric carbon sinks and conserving ecosystems and biodiversity. The most widely agreed definition for SFM states that it is:

[21] http://www.unccd.int/en/programmes/Thematic-Priorities/Food-Sec/Pages/FS-SLM.aspx.

"a dynamic and evolving concept that aims to maintain and enhance the economic, social and environmental value of all types of forests, for the benefit of present and future generations." [22] (GEF)

While SLM and SFM are essential components of any effort to halt land degradation, there is increasing recognition that conservation and sustainable use are no longer sufficient to stem the loss of ecosystem services and achieve ZNLD (Aronson and Alexander, 2012; CBD, 2012a). The second pillar of ZNLD therefore calls for alleviating the decline in land productivity by restoring land that is already degraded. It is estimated that there are more than 2 billion hectares of degraded lands with potential for forest and mosaic restoration[23] worldwide (GPFLR, 2011).

3.2.1. *Principles for scaling up sustainable forest and land management*

There is no single 'miracle solution' to avoid the problems of land degradation and accomplish the above-mentioned actions (Woodfine, 2009). This is highlighted in the resilience framework, according to which actions to halt land degradation are aimed at strengthening the natural, financial, political, human or physical capital base of the system. Specifically with respect to scaling up ecosystem restoration efforts, SFM and SLM , a number of enabling factors have been identified (e.g. in the ELD initiative[24]; FAO, 2011b; World Bank, 2006; Terrafrica, 2008; UNCCD, 2009c; CBD, 2012b). These are:

- Multilevel involvement and partnerships among governments, corporations and communities;
- Robust local capacity-building by non-governmental organizations and other cooperative-type projects;
- Research and technological development;
- Monitoring of land degradation and land improvement;
- Open-access transfer of knowledge, guidance, tools and technologies;
- Sound macroeconomic management that does not discriminate against agriculture and natural resources;
- Targeted policy and institutional support including finance and other incentive mechanisms;
- Correction of policy failures such as distortionary price and trade policies; and
- Engagement with the private sector.

These factors and how they can facilitate the scaling up of SLM, SFM and restoration practices will be tackled in Chapter 4. Initiatives with a specific bearing on the economics of DLDD will be emphasised.

3.3. CONCLUDING COMMENTS

The objective of resilience management for sustainable dryland and drought risk management is to ensure the continuation of dryland functions and services, reduce the costs of disruption, ensure a structured return after a shock or adaptation in response to long-term impact stressors such as climate stress. Resilience-building requires investment in enabling policy environments and human resource development. The virtuous cycle for improvement begins by either avoiding land

[22] http://www.thegef.org/gef/SFM.
[23] Mosaic restoration: Forests and trees are combined with other land uses.
[24] http://eld-initiative.org/index.php?id=23.

degradation or offsetting it through land restoration. Improving land condition leads to improved rain infiltration, increased water storage in soils, increased water availability, more biomass and greater food security, which in turn reduces pressure on land and the conversion of forest to cropland (UNCCD, 2009c).

4. POLICIES AND ECONOMIC INSTRUMENTS TO INDUCE SUSTAINABLE LAND MANAGEMENT

Due to the multitude of underlying and proximate causes of DLDD specific to each location, policy instruments for scaling up SFM, SLM and ecosystem restoration will need to be devised. As argued in the first part of this chapter, these policy instruments will need to include institutional strengthening, economic policy reforms and the correction of policy failures. The remaining part of the chapter takes a closer look at each of these instruments. It first considers the importance of learning through so-called multi-level interactions, then shows how economic instruments (such as fiscal policies or payment for environmental services) may be used to effectively alter land use changes. The chapter then considers the importance of regulatory reforms and correcting policy failures, and finally shows the potential role of the financial or private sector in mobilizing resources for sustainable land-use practices.

4.1. OVERVIEW OF ENABLING FACTORS

Public policy instruments for sustainable land use may be of a regulatory, economic or advisory nature (OECD, 1994). The principles of SLM hinge on **multi-level engagement and advisory approaches** that respects local knowledge and deal with the complexity of land management decisions through participatory approaches and stakeholder involvement. These approaches could form the basis for defining sound regulatory or economic instruments to be implemented by central governments. **Regulatory instruments** to foster SLM typically tend to specify quantity standards on emissions, land and water-use practices, and stipulate a variety of penalties for non-compliance. However, by specifying inflexible limits or technological requirements, these types of command and control regulations are often ineffective or costly to society and landholders. On the other hand, **regulatory reforms,** for example to improve the tenure security of smallholders, may be very important to promote more sustainable and productive land management practices. **Economic approaches** serve to create incentives for SLM through the market. Such environmental markets, although non-existent historically, are emerging in many countries and also at international level (carbon, water and biodiversity markets) (Bishop et al., 2012). In addition to these approaches, it is important that **policy failures** are tackled**.** These generally result from weak or ineffective implementation of environmental policies or from the unintended impacts of economic development polices and investments.

Finally, **the private sector** is also an important player in the transition to the increased use of SLM practices. The main stakeholders who make direct or indirect use of land production services are enterprises in the agro-, timber, food, tourism and financial service industries (ELD[25]).

4.2. MULTI-LEVEL APPROACHES FOR BETTER POLICIES

Imperfect information or so-called information asymmetries are prevalent at multiple scales and can make it significantly more difficult for smallholders to adopt sustainable land practices or for policymakers to design policies that produce the intended consequences.

At farm level, land restoration or the adoption of SLM practices might be constrained when degradation effects or their causal factors are not observable by farmers without modern measuring

[25] http://eld-initiative.org/index.php?id=27

devices. Such situations may occur with soil acidification, micronutrient depletion, changes in microfauna or the spread of disease vectors (World Bank 2006). Inadequate knowledge about land-use practices or appropriate technologies that are in the private landowner's own financial interest can simultaneousy hinder the take-up of SLM. In these cases, advisory approaches such as education and awareness-building may be used (Engel et al., 2008). But technology developers may lack information about cropping patterns and practices that could serve the priorities of farmers and at the same time contribute to soil conservation (World Bank 2006). Furthermore, programme administrators might not understand how SLM would affect farmers' production plans and profits (Latacz-Lohmann and Van der Hamsvoort, 1997).

The contention of this background paper is therefore that significant gains can result from understanding and respecting traditional and local approaches to natural resource management. When adopting a multi-level stakeholder approach to SLM, scientific information must be coupled with indigenous knowledge to offer a better basis for decision-making in the negotiation processes (Hurni 1997). The practical reality is one in which many practitioners in the field have limited access to land resource mapping and information about the effectiveness of traditional and innovative SLM approaches that would enable good practices to be sustained and scaled-up (GEF 2012b).

Another unfortunate consequence of insufficient multi-level integration is that dryland populations have little representation in formulating national strategies to combat desertification and reduce poverty. For example, policymakers have often overlooked whether policy options were built on customary patterns and arrangements for grazing and mobility (UNCCD 2009).

There is hence much scope for further combining local, scientific and governmental knowledge for better decision-making. Government policies and institutions in particular play an important role in mainstreaming the monitoring and assessment of land degradation into government land-use planning and decision-making (Akhtar-Schuster et al., 2010). Government policies and institutions are also necessary to build the capacity of local governments to enhance the effectiveness of local institutions. This should not be undermined. Studies have shown that people are more likely to comply with regulations enacted by local councils than with regulations imposed by higher authorities (Nkonya et al. 2011; Ndegwa and Levy, 2004).

International conventions that link the environment and development to SLM (such as the UNCCD) add another important dimension to the quest for enabling policies and approaches to tackle DLDD. Figure 2 shows the different activities and levels of intervention in a multi-stakeholder approach to sustainable development (see Hurni 1997 for an in-depth analysis).

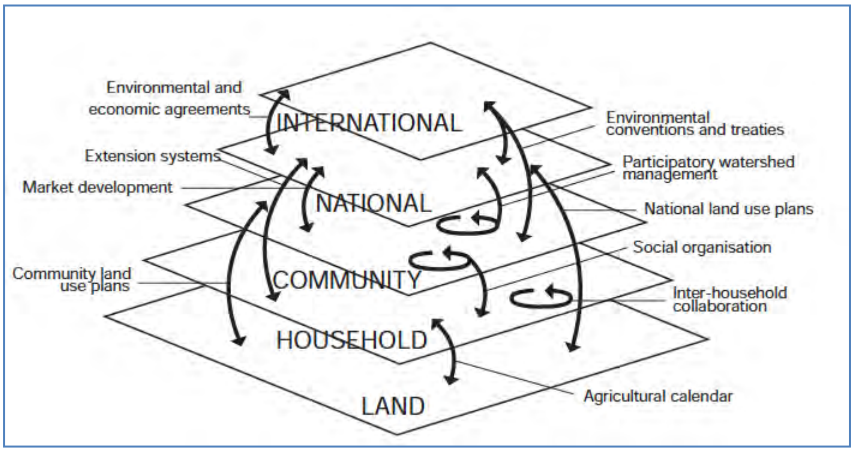

FIGURE 2: INTERVENTION LEVELS AND ACTIVITIES IN A MULTI-LEVEL STAKEHOLDER APPROACH TO SUSTAINABLE LAND MANAGEMENT. (HURNI 1997)

In a setting characterized by significant information asymmetries and numerous possible interlinked causes of DLDD, top-down command and control policies will most likely fail to 'attribute' the necessary resources or the right incentives for transitioning to SLM.

To overcome such information asymmetries, there is increasing consensus that participatory[26] and multi-level approaches can help in designing effective land management policies that cater to the complexities of the field otherwise overlooked by the centralized government (Stringer and Reed, 2007; Glover 2010; Nkonya et al. 2011). In particular, there needs to be a strong link between farmers, the extension system and agricultural research to develop and disseminate agricultural technologies that respond to the farmer's needs. Evidence suggests that this link needs to be strengthened (GM 2009).

4.3. USING ECONOMIC INSTRUMENTS FOR SUSTAINABLE LAND MANAGEMENT AND ECOSYSTEM RESTORATION

Chapter 2 described the association of DLDD with a number of direct and indirect, on-site and off-site costs. Thus, while many of the more sustainable land management practices benefit the public (rival and non-excludable), the costs of undertaking SLM fall on actors 'on-site'. This is because land users' investment decisions tend to focus on purely financial considerations, discounting or neglecting the costs or benefits that accrue to society as a whole as a result of their decisions. When there are externalities from land-use practices, markets generally fail to deliver sufficient (efficient) quantities of public goods and favour the production of private goods for which markets and prices exist.

The divergence between the private and the social paths in soil use in least developed countries (LDCs) is further exacerbated by imperfect information, high transaction costs, imperfect insurance and capital markets, incomplete property rights and misguided government policies. Moreover, the interlinkages between poverty, population growth, and environmental degradation also complicate and reinforce the potential impact of market imperfections (Shiferaw and Holden, 2000). This means

[26] Participatory approaches adhere to processes of interactive dialogue, e.g. in focus groups and deliberative forums, and collective learning through creative tools and techniques.

that individual users fail to take on soil conservation investment, leading to the excessive degradation of the land. Possible policy responses are outlined in the following.

4.3.1. Economic instruments: market based instruments and payment for ecosystem services

Market-based instruments (MBIs) may be grouped into price-based, quantity-based and market-based facilitation approaches. **Price-based approaches** include conservation tenders, environmental taxes, user fees, fines, bonds and royalties, tax rebates and subsidies, all of which aim to influence the behaviour of producers and/or consumers by altering prices and therefore costs or profits. **Quantity-based approaches**, on the other hand, typically modify the rights associated with the use of natural resources. In some cases, these rights may be tradable. Examples include tradable emissions permits under the European Union Emissions Trading System, individual transferrable fishing quotas (ITQs), pollution permits and biodiversity offset schemes.

Market facilitation approaches aim to make existing markets work better by enhancing information, lowering transaction costs, and increasing confidence among market participants. Examples include the 'green' or 'eco' labelling of products that have been grown according to standards of sustainable land management. Auctions of conservation contracts (as shown in section 4.3.2 below), which bring bidders and sellers into contact at minimal cost, is another promising tool for mobilizing new resources for ecosystem restoration and SLM.

The basic idea of using economic instruments to promote SLM is that those who engender land degradation or damage soil productivity must pay the costs either to those directly affected or to the state, who will act on behalf of the affected. For instance, if farmers over-irrigate the land, leading to salinization, then irrigation prices should be recalibrated to incentivize farmers to irrigate in socially optimal quantities (Braun et al., 2012). Alternatively, under a cap-and-trade mechanism, land managers would be given permits for water infiltration or other contributions to the salinity risk. Land managers who do not use their permit entirely can sell the excess to those who require extra (Rolfe and Mallawaarachchi, 2007).

Economic instruments also work in the other direction. Those entities that provide benefits by lowering, for instance, off-site impacts of land degradation should be compensated for their efforts, either directly by beneficiaries or indirectly by the state (CBD, 2011).[27] PES incorporates this principle and as such they are attractive in settings where ecosystem service providers are poor, marginalised landholders or powerful groups of actors (Engel et al., 2008).

In the absence of economic instruments, insufficient resources will be devoted to avoiding or minimizing the impacts of DLDD as well as SLM.

MBIs specifically offer enhanced efficiency and effectiveness over regulatory approaches when they are well designed and applied in an enabling context. They are likely to outperform other regulatory instruments where there are large variations in the ability of landholders to furnish desired services and when there is flexibility in the range of practices that will deliver the desired outcome. These differences can only be harnessed through a market mechanism that provides continuing incentives to reduce costs and undertake better practices. However, competitive markets for environmental

[27] Secretariat of the Convention on Biological Diversity (SCBD) (2011) Incentive measures for the conservation and sustainable use of biological diversity. Technical Series No. 56. Montreal, Quebec, p. 1–66. Accessed 20/11/2011 at http://*www.cbd.int/doc/publications/cbd-ts-56-en.pdf.*

outcomes do not arise spontaneously. Hence good governance or good governments are required to create and support effective MBIs (Whitten et al., 2004).

4.3.1.1. Example of the application of a bidding scheme to tackle land degradation in China

In a comprehensive analysis of whether the introduction of market-based instruments would improve the efficiency of key land-use change programmes in China, Bennett et al. (2011) investigated the feasibility of a bidding scheme for conservation contracts to allocate government ecological funds. The authors found that the bidding scheme was both practically feasible and improved the environmental targeting of ecological restoration compared to the fixed payment programmes, i.e. more cost-effective. The bidding scheme was also found to bring a number of community benefits, including local capacity-building for officials, technicians and farmers, the building of trust between officials and farmers, increased environmental awareness of local farmers and more decision-making power being given to local farmers in land-use management. Along with a growing number of other studies (see e.g. Ferraro, 2008; Uwe Latacz-Lohmann et al., 2006; Connor et al., 2008), this study shows that there is potential to increase the efficiency of public or private sector funding for ecological restoration through the introduction of a competitive bidding process.

Box 2: Introduction to Auction Design to tackle land degradation

Auctions are increasingly being used as a payment mechanism to acquire public benefits, such as conservation actions that produce environmental improvements on private land (e.g. the United States Conservation Reserve Program (CRP)). The economic rationale for the use of auctions is that they create decentralized incentives to offer bids at close to the true landholder opportunity costs even when the implementing agency holds little information about these opportunity costs (Connor et al., 2008). Under an action mechanism like the one applied by Bennett et al. (2011) in China, the land to be 'restored' or used differently is identified through a competitive bidding scheme where landholders in selected regions are asked to bid for funds to undertake land improvement services. Because of competition, farmers have an incentive to reveal their true compliance costs. This reduces over-compensation and increases cost-effectiveness. Bids submitted by participating farmers are ranked on the basis of two key components. The first is the farmer's bid price, which normally comprises their compliance costs of the conservation contract, opportunity costs of their foregone benefits from previous land practices, and a risk premium in the case of losses arising beyond the farmers control (Bennett et al., 2011). The net benefit of each bid is derived using bid price information and potential environmental benefits that the nominated conservation activities in the bid would generate. The environmental benefits may be estimated using one or a combination of methods from the **valuation toolbox** in chapter 2. Bids are ranked on the basis of the benefit-cost ratio of each bid. Providers with the highest benefit-cost ratio of environmental goods and services are identified and selected for the conservation contracts until government funding is exhausted.

4.3.2. Cross-compliance – the interest in mixing instruments

The appropriate choice of policy instrument for promoting SLM or ecosystem restoration ultimately depends on the environmental effectiveness, costs of contracting, monitoring and enforcement, distributional effects, conformity with other policies and political preferences. In some instances – where administrative and enforcement costs are within reasonable bounds – a mix of regulatory and economic incentives may be the most appropriate. Cross-compliance (interlinkage) means that conservation objectives are linked to access by a vital input (e.g. irrigation water). This may be particularly attractive in LDCs. Subsidies on productive inputs linked to conservation can enable poor households to comply with conservation requirements without the adverse impacts on their welfare.

In Ethiopia, for instance, Shifera and Holden (2000) showed that if input subsidies (for fertilizer and improved seeds) were offered on the condition that upland cereals were grown on land with conservation structures (soil-stone bunds), then soil erosion was countered without adverse impacts on food and the welfare of the poor. In contrast, when input subsidies were provided without conditions, the enhanced profitability of farming discouraged the need to conserve the soil stock. These results are consistent with general environmental economic theory which tells us that a combination of instruments is needed in a second-best world where several sources of market failure coexist.

4.3.3. Cost-benefit analysis for designing economic instruments

Correcting price signals, assigning quotas, selecting bids or providing optimal compensation payments for environmental services requires knowledge of the potential environmental benefits of land-use change. By discounting all costs and benefits to yield a net present value, future costs and benefits of investment in SLM or ecosystem restoration versus continued degradation are made comparable through CBA.

When financial resources are limited, multiple CBAs assessing space – also called spatial CBAs – can help prioritize which projects yield the largest net benefit (Naidoo et al., 2006). Specifically with respect to PES, when the number of applications to participate in a PES programme exceeds available financing, off-site service buyers can target applicant sites based on cost and benefit considerations that maximize the programme’s financial efficiency (Engel et al., 2008).

This paper therefore recommends that potential land-use changes be evaluated using CBAs. The practical reality, however, is one in which worldwide payments made by governments to stimulate land-use change are determined by political or budgetary considerations rather than the economic valuation of benefits and costs involved (Bennett et al., 2011).

As an example from South-East Asia shows, one-size-fits-all policies are not always effective. In 1999 China adopted the “Conversion of Cropland to Forest and Grassland Program”, a nationwide ecological recovery programme that aimed to incentivize farmers to convert cropland to forests and grasslands by providing a single rate of payment independent of their location. Bennett and Kontoleon (2009) argue that while the programme has proved successful in achieving sustainable land use in Southern China, this is not the case in Northern China. Uchida et al. (2005) suggest that 40 to 84 per cent of the programme area had opportunity costs well below the compensation offered. Both of these analyses suggest that resources could have been employed more effectively by accommodating payments for the opportunity costs faced and environmental services provided in different geographical locations. Economic instruments such as auction tenders have emerged in recent years to allow resources to be allocated in a more efficient way and facilitate true price discovery (Eigenraam et al., 2007).

4.4. TACKLING POLICY FAILURES – PART OF A COHERENT STRATEGY FOR HALTING LAND DEGRADATION

Tackling information asymmetries and correcting market failures through participatory approaches and market-based instruments are important ingredients of any strategy that aims to promote SLM. Addressing policy failures is integral to this effort.

Policy failures arise on the one hand when public policies do not achieve their purpose and have unintended adverse consequences. For instance, land degradation and desertification may result either from weak or ineffective implementation of environmental policies or from the unintended impacts of economic development polices and investments. On the other hand, policy failures also result from the promotion of activities that tend to encourage over-production and over-exploitation of the natural environment. Examples of the latter are subsidies for energy, road transport and other infrastructure, commercial fishing, heavy industries and agricultural production that are not in accordance with sustainable practices.

Many countries implicitly or explicitly subsidize practices that increase land degradation or tax activities that tend to reduce degradation. Examples include subsidies for the cultivation of upland crops that drive expansion into the marginal lands, subsidies on water and energy in irrigation schemes, tariff protection for land degrading crops, and fertilizer subsidies, which distort incentives for using inorganic fertilizer rather than other practices (GM, 2009). Reversing these policies would have high benefit-cost ratios, since their net costs are low or even negative as long as political costs are disregarded.

Agricultural subsidies are estimated at about USD 261 billion per annum for OECD countries, the majority of which are not tied to or conditional on environmental performance. Energy subsidies for the OECD are estimated to be around USD 500 billion per annum globally (TEEB, 2010). Correcting for market failures and information asymmetries will not achieve intended benefits as long as other major distortions prevail in any one economy.

4.5. REGULATORY REFORM TO FACILITATE SUSTAINABLE LAND MANAGEMENT

Legal, regulatory and administrative reforms are generally necessary to help scale up SLM practices. In particular, regulatory reform may reduce transaction costs involved in SLM produce reaching the markets and as instruments for helping internalize external effects, for example by setting up mechanisms for resolving disputes, issuing compensation and ensuring secure land tenure (GM, 2009). The importance of secure land tenure as a means to improve incentives to invest in SLM is given special attention in section 4.5.1. Finally, regulatory reforms are important as a means to tackle financial market failures. Poor rural households generally face severe discount rates, hindering access to credit that would enable them to finance potentially profitable investments in land management.

4.5.1. Role of secure land tenure

Overexploitation of soils is often rooted in local property rights disputes and insecure tenure[28] (Weigelt et al., 2012). When clearly specified, well defined, and enforceable, property rights or long-term lease holds are important in facilitating good resource management directly or through the facilitation of incentive schemes such as MBIs (Crosson and Anderson, 1993). According to the World Bank (2006), it is unlikely that SLM can be achieved if property rights are not explicitly considered. On the one hand, they help improve access to credit and constitute important aspects regarding the welfare of households and communities who depend on those resources. On the other hand, they help extend the planning horizon for the poor and vest the land user with the benefits of investing in land improvement and conservation (Panayotou, 1993).

Research indicates that secure rights do indeed induce higher investment and productivity in developing countries. A study from Nicaragua found that awarding registered titles increased land values by 30 per cent and greatly increased the propensity of landholders to invest in the land (Deininger and Chamorro, 2004). In the Niger, farmers started actively protecting or planting trees once they were given a mandate to own the trees and their land (Botoni and Reij, 2009). On the contrary, an example from China shows that when logging was banned to reduce the incidence of dust storms and floods in 1999 through the Natural Forest Protection Programme, it had the perverse incentive of discouraging the replanting of production forest (Bennett and Kontoleon, 2009). This happened essentially because the banning of logging implied taking away user rights from forest landholders.

Land-use rights do not necessarily need to be assigned to individuals in order to capture the benefits of secure tenure. In drylands, empowering local communities to manage open-access rangelands as a commons has in some cases been sufficient to reduce grazing intensity and halt land degradation (Coxhead and Øygard, 2008).

These examples demonstrate the importance of addressing land tenure in national policies and statutes. According to GM (2009), achieving tenure security depends critically on the effective operation of the local and national institutions within the land administration and wider legal and judicial system. Key challenges are finding cost-effective ways of delineating and documenting land rights and ensuring that dispute resolution procedures are not subject to manipulation.

4.6. Private sector engagement

Investment in activities that maintain or increase the stock of natural capital held in soils (such as SLM) can secure a vital flow of ecosystem goods and services (discussed in chapter 2). However, some of these activities often fail to address the underlying drivers of land degradation. Since land or forest degradation is often linked to economic activity, it is important that investment is steered towards activities that have zero or a positive impact on the natural capital base while providing economic benefits. Investments in sustainable forest and land management are currently dwarfed by the flow of finance to activities that cause unsustainable land degradation (GCP, 2012). However, there are a number of ways by which finance can be raised for sustainable forest and land management. In the following we highlight different sources that can help increase the availability of finance for sustainable land-use activities. This is a complex subject and will not be discussed in-

[28] In simple terms, land tenure systems determine the allocation of property and use rights within societies, defining who can use what resources for how long and under what conditions.

depth due to the nature of this study. This section draws from GCP (2012) unless another reference is provided.

4.6.1. Loans, equity, bonds, crowd-financing and grants

As mentioned in section 4.5, smallholders often face prohibitively high interest rates on loans that would have permitted them to invest in SLM practices that generate profits from agricultural community sales. This may be the result of imperfectly functioning credit markets or simply because the lending organization considers the project or activity too risky. In this situation, a development bank may offer a concessional loan to a commodity producer to finance his transition to more sustainable agricultural practices. Concessional loans have an interest rate that is lower than the market rate or a repayment schedule where interest is not paid for a period.

Equity capital is provided by an investor in exchange for partial ownership (called equity) and sometimes influence over the decision-making of an organization. Some equity investors, labelled 'impact investors', accept a lower rate of return in exchange for environmental and social benefits. An impact investor may be interested in funding the expansion of an organization that generates revenue through, for example, eco-tourism, and which has a greater focus on social outcome.

Another type of capital, which is used to finance investments related to climate, forests and sustainable agriculture, is known as 'green bonds'. A bond is an agreement where investors provide up-front capital to an organization in return for a promise to pay the investor the value of the bond plus periodic interest payments. World Bank Green Bonds finance the bank's portfolio of climate-related investments (Reichelt, 2012). Some green bonds have been issued by private organizations and tend to finance agriculture and forestry, although very few bonds are issued by companies that generate all their revenues from sustainable agriculture and forestry. The Climate Bond Initiative (2012) estimates that public, private and multilateral institutions have issued USD 174 billion worth of bonds fully aligned with the climate economy, of which USD 730 million has been applied to sustainable forestry and agriculture.

Crowd funding offers an entry point for individual investors to support a specific project with their own capital. Typically, a large number of individual investors from around the world collectively contribute small sums of money. As such, crowd funding can be used to finance SLM practices in cases where larger investors are less supportive. Crowd funding tends to use the internet with websites such as Kiva (www.kiva.org), Kickstarter (www.kickstarter.com) and Fundable (www.fundable.com).

For enterprises that intend to generate revenues but are not far enough along in their development to receive loans or bonds, grants-based funding may be an important source of capital. Grants are non-repayable funds disbursed by one party, often a government department, corporation, foundation or trust fund. Trust funds tend to finance watershed management, protected areas and other 'biodiversity-friendly' projects. Trust funds are typically capitalized by grants from international donors and host governments. Many private companies are also beginning to provide grants. Walt Disney, for instance, is financing Conservation International's Alto Mayo project in threatened forests in northwestern Peru. Grants go towards financing agroforestry systems, planting native species and expanding sustainable livelihood practices among local villages (CI 2011).

There are different mechanisms for scaling-up the above-mentioned sources of finance and reducing the risks. Planning and coordination will help an organization direct investments more effectively; subsidies will support the generation of revenue; a loan may be supported by a guarantee;

certification adds value to a product and drives conscious consumer activities; clearing houses link projects with the financiers looking to provide capital to a project (e.g. the CBD LifeWeb initiative). These latter initiatives fall under the above-discussed market-based or market-facilitation instruments. Numerous other catalysts can be identified (see GCP 2012).

4.7. Concluding comments

SLM and ecosystem restoration are the key to enhancing the resilience of systems that are vulnerable to DLDD. Effective policies need to be based on a good understanding of the challenges faced on the ground. Generally speaking, policies that have successfully addressed a transition to more sustainable land-use practices have used participatory approaches, responded to local perceptions and priorities, enjoyed adequate government and civil society backing, and promoted technical packages with low risk and strong economic incentives (GM 2009; Davies et al. 2012). Economic instruments specifically offer a promising avenue for addressing DLDD and provide incentives for managing land sustainably. However, economic instruments are not appropriate for all natural resource allocations (World Bank 2006). When there are difficulties in specifying property rights, identifying and monitoring changes, and enforcing transactions, these instruments will be less effective or impossible to apply. Over time, advances in information communication technologies may facilitate transactions between disparate parties and thus reduce transaction costs. Improved resource monitoring through satellite imagery will also make it easier to monitor changes with respect to the baseline so as to match (polluter or beneficiary) payments with outcomes. Independent of the feasibility of using PES or MBIs, addressing policy failures and securing land rights are good places to begin. Addressing weak governance and policy-induced distortions that operate through markets to promote land-degrading activities are arguably amongst the most efficient means of tackling land degradation in developing countries. Lastly, given a rising global demand for commodities built on an unsustainable price signal (e.g. wheat price speculations) that converts natural capital for free to provide food, fibre, fodder and fuel, finance must become more accountable for its impact on nature, creating opportunities for change (GCP, 2012).

5. Implementation of the Rio conventions – a call for synergies to advance the economics of desertification, land degradation and drought

This chapter begins by highlighting the interlinkage between climate, land, fauna and flora. This interlinkage implies that the Rio Conventions share a number of synergies that may be harnessed from the perspective of tackling land degradation, biodiversity loss and climate change in a more efficient manner. Possible synergies in policy responses to the three Rio Conventions are outlined, highlighting ZNLD as a target. The chapter then considers existing initiatives to foster further synergies between the Rio Conventions. The second part of the chapter argues that scaling up CBA and resource mobilization for ZNLD requires consistent baselines for desertification, land degradation, biodiversity conservation, carbon emissions, sinks and sequestration rates, and socioeconomic factors (GM 2009). Given a contemporaneous lack of reliable and consistent time-series data on the state of the environment and socioeconomic parameters (GEO-5 2012), knowledge management systems should insist on establishing harmonized approaches to collecting and storing biophysical and socioeconomic data. A number of initiatives show that progress is being made in this respect.

5.1. UNFCCC, UNCCD and CBD – synergies in issues, causes and policy responses

The Earth Summit in Rio de Janeiro in 1992 was a landmark in the global effort to preserve our planet's health. Desertification, climate change and the loss of biodiversity were identified as the greatest challenges to sustainable development during this meeting. The topics of the three Rio Conventions – the United Nations Convention to Combat Desertification (UNCCD), the United Nations Framework Convention on Climate Change (UNFCCC) and the Convention on Biological Diversity (CBD) – have become an integral part of the international, environmental and political agenda.

Twenty years after the Earth Summit in June 2012, the world gathered in Rio again for the United Nations Conference on Sustainable Development (UNCSD), also known as Rio+20. The Rio+20 outcome document 'The Future We Want' urges "all Parties to fully implement their commitments" under the conventions "in those countries experiencing serious drought and/or desertification…" Moreover, the outcome document recognizes "the economic and social significance of good land management, including soil, particularly its contribution to economic growth, biodiversity, sustainable agriculture and food security, eradicating poverty, women's empowerment, addressing climate change and improving water availability".

This latter statement makes implicit the interlinkages between the three Rio Conventions. Good land management has direct implications for biodiversity and climate change. Similarly, SLM, biodiversity conservation and climate change mitigation can all be promoted with sound policies and appropriate economic instruments. But no sound assessments can be made without access to underlying biophysical and socioeconomic indicators. Without assessments, effective and equitable economic instruments cannot be prescribed. As this section will show, there is significant scope for improving the existing collaboration among the Rio conventions with respect to data collection, monitoring and socioeconomic assessments.

5.1.1. Internal feedbacks and synergies in issues

DLDD, climate change and biodiversity are tightly linked, both in terms of their underlying human-environmental causes but also with respect to their mutual reinforcement and numerous ‘common issues’. Forests, for example, are necessary to help stop the spread of desertification. They are also important in conserving biodiversity and in the climate change agenda with regard to both mitigation and adaptation (Terrafrica, 2009).

With respect to internal feedback within the Rio Conventions, soil conservation or, more broadly, ZNLD, could precipitate multiple global benefits in terms of biodiversity conservation, carbon storage, agricultural productivity and poverty reduction. As shown in figure 3, continuing land degradation directly contributes to the ongoing losses in biodiversity (Thomas 2008) and biomass, which reduces above-ground and below-ground carbon storage, sequestration potential and climate change mitigation potential. Lower climate change mitigation potential leads to greater exposure to droughts and prolonged heat waves. Loss of agricultural output and biodiversity and increased vulnerability to droughts further aggravates social unrest and poverty. Poverty often leads to the over-exploitation of the land with inadequate soil and water conservation practices (Olsen and Berry, 2003) and hinders the take-up of SLM, as this typically involves up-front costs (see figure 3). Although the system and how the different ‘components’ interact is a great deal more complex in reality, it does illustrate one set of feedbacks that exists between the thematic cornerstones of the UNCCD, UNFCCC and the CBD.

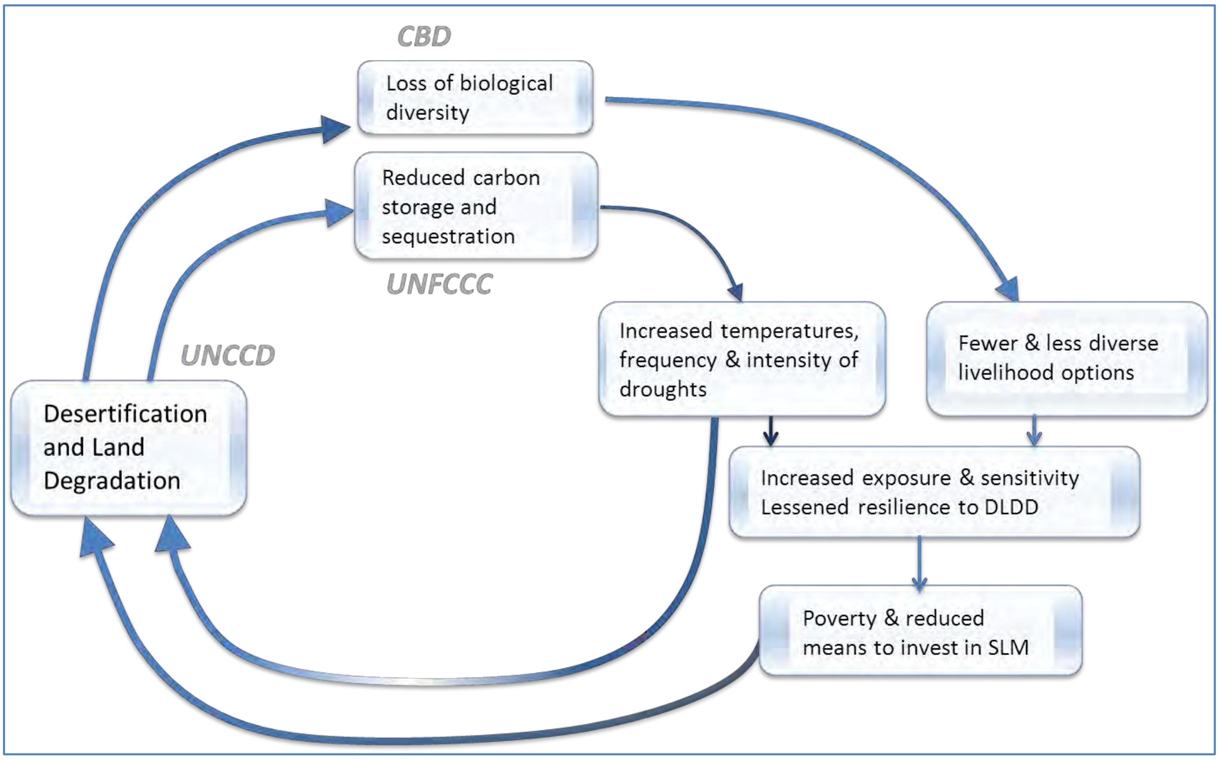

FIGURE 3: A SNAPSHOT OF A SET OF FEEDBACKS BETWEEN THE THREE RIO CONVENTIONS (DEVELOPED BY THE AUTHORS)

5.1.2. Synergies in causes

Climate change, land degradation and biodiversity loss also share the same underlying causes. All three processes are the result of combined market, information and policy failures. In the first instance, ‘markets’ fail to deliver socially optimal quantities of crucial ecosystem goods and services.

This is because the respective agents and actors who contribute to the problems of biodiversity loss, climate change, and DLDD engender costs to society that are partially borne off-site by third parties.

Loss of biodiversity, climate change and DLDD may therefore all be addressed by creating the kind of incentives that change the behaviour of economic agents (from households to primary producers or large enterprises). As highlighted in chapter 4, this necessitates the internalization of external costs in accordance with the 'polluter pays principle' or conversely, that adequate compensation is paid to those who deliver public goods such as ecosystem restoration or SLM. Tackling policy failures means that harmful subsidies that encourage over-production and over-exploitation of the natural environment should be removed, environmental policies should be effectively implemented, and unintended impacts of economic development polices and investments should be avoided.

5.1.3. Synergies in policy responses – the case for zero net land degradation

Ecosystem restoration has become a cross-cutting theme in the three Rio conventions. In 2012, the UNCCD released an executive summary of a policy brief titled "A Sustainable Development Goal for Rio+20: Zero Net Land Degradation" which suggests that land degradation neutrality can be achieved when land degradation is either avoided (through SLM) or offset by land restoration (UNCCD 2012c).

While SLM is coherent with the CBD, in particular Aichi Targets 7[29] and 15,[30] the Hyderabad Call at COP 11 (CBD 2012a) affirmed that conservation and sustainable use alone are no longer sufficient to stem the loss of biodiversity and ecosystem services. The Hyderabad Call for concerted effort on ecosystem restoration was supported by 14 parties including the governments currently hosting the three Rio Convention presidencies, namely India (CBD), Republic of Korea (UNFCCC) and South Africa (UNCCD).

The Call notes that "the effective implementation of restoration projects and programmes not only helps to achieve many of the Aichi targets under CBD, but also ecosystem based adaptation and climate change mitigation under the UNFCCC, striving towards land degradation neutrality and ZNLD under the UNCCD…." This Call (together the with the Note from the CBD Executive Secretary) contributed to the deliberations leading to the CBD COP 11 decision XI/16 on ecosystem restoration, which notes "that ecosystem restoration will play a critical role in achieving the Strategic Plan for Biodiversity 2011–2020, including the conservation of habitats and species. Furthermore, it is recognizing that ecosystem restoration can contribute to climate change mitigation and adaptation, socio-economic development and food security".

Hence, it is increasingly clear that climate and land cannot be viewed separately. Reducing emissions from deforestation and forest degradation (REDD) and more recently, forest restoration and rehabilitation (REDD+) are therefore also at the forefront of climate change negotiations. At the 2012 UNFCCC COP 18 meeting in Doha, Qatar, Forest Day 6 focused on the broader role of forests in landscapes as a whole and their connection to agricultural sectors to deliver a more integrated approach to landscapes at COP 19 next year (Steffen, 2012). Forestry experts called for a new approach to tackling climate change, arguing that watershed management and habitat restoration should be done in concert with addressing climate change challenges. Forests should not be

[29] Aichi 2020 Target 7: By 2020 areas under agriculture, aquaculture and forestry are managed sustainably, ensuring conservation of biodiversity.

[30] Aichi 2020 Target 15: Ecosystem resilience and the contribution of biodiversity to carbon stocks have been enhanced, through conservation and restoration, including restoration of at least 15 per cent of degraded ecosystems.

sacrificed for the sake of rural development and food security, but safeguarded or restored for this very purpose (Kovacevic 2012). Managing soil to increase infiltration as well as below-ground and above-ground carbon storage may contribute to climate change adaptation, mitigation and pro-poor resilience-building.

As highlighted by UNCCD Executive Secretary Luc Gnacadja, there is a need for a real paradigm shift towards synergies in the Rio Conventions (UNCCD, Gnacadja 2012d). While climate change, biodiversity loss and DLDD share common drivers or causes, the responses are also embedded in the same overarching targets and policy formulations. With regard to ZNLD, restoring degraded lands and intensifying sustainable production to accommodate 2 billion new inhabitants over the next 30 years offers one practical response to all of the three Rio Conventions.

5.2. UNFCCC, UNCCD AND CBD – SYNERGIES IN IMPLEMENTATION

The many synergies in causes, issues and possible responses shared by the three Rio Conventions mean that there is significant scope for synergies in implementation. Effective implementation requires an integrated approach based on stronger collaboration in order to (i) strengthen activities in a synergistic manner; (ii) reduce potential conflicts between independent Rio convention activities; (iii) avoid duplication of efforts; and (iv) use available resources more efficiently (UNFCCC 2004). This is not to be undermined. Lack of financial support from donors has historically hindered the effective implementation of the UNCCD (TerrAfrica, 2009). Part of the problem is that land degradation has for a long time had a low priority among donors, whether international or national governments, in comparison with biodiversity or climate change. One of the recent initiatives undertaken by the GEF to enhance Rio synergies is a template for joint reporting of the national communications. Joint reporting implies that the focal point for each of the Rio Conventions will need to communicate, thereby spurring the creation of synergies at country level (Barbut, 2012).

Other options for building synergies among the Rio Conventions in specific cross-cutting areas include capacity-building, technology transfer, research and monitoring, information exchange and outreach, reporting, and financial resources (UNEMG, 2011; UNFCCC, 2004).

Numerous collaborative efforts between the UNCCD and the other Conventions have been established to address the need for further integration and collaboration (see table 3). These include joint work programmes, country-driven initiatives and workshops (UNEMG, 2011). However, while these have fostered dialogue at the international level by engaging representatives from the three Conventions, they have not allowed for adequate vertical transfer to regional, national and local levels (Akhtar-Schuster et al., 2010). Lack of vertical integration manifests itself when those working at the national and international levels are unable to tap into the data and expertise of those who manage the land, who in turn never see the benefits of national, regional or international monitoring programmes (Reed et al., 2006).

While the importance of international biophysical and socioeconomic monitoring programmes as well as the assessment of desertification and land degradation were dealt with at the UNCCD 1st Scientific Conference in 2009, we recapitulate elements and recent developments in the following. This is because the use of impact assessments and CBAs for defining policies and generating new funding for, for example, meeting the ZNLD target, are seriously constrained without a scientifically robust and consistent baseline of desertification, land degradation, biodiversity conservation or carbon emission sinks and sequestration rates. The rest of the paper argues why these efforts may help render local, national and international efforts to tackle climate change, DLDD and biodiversity loss more effective in delivering results on the ground.

TABLE 3: BUILDING SYNERGIES BETWEEN THE THREE RIO CONVENTIONS. COMBINED FROM AKHTAR-SCHUSTER ET AL., (2010) AND THE GEF (2012)

Cooperating Multilateral Environmental Agreements	Initiative	Purpose
United Nations Convention to Combat Desertification (UNCCD) and Convention on Biological Diversity (CBD)	Joint work programme (JWP) on the biological diversity of dry and sub-humid lands	The JWP contains four main elements: assessments, targeted actions for the conservation and sustainable use of biological diversity and enabling activities, and joint reporting. Each detail of joint or shared activities is coordinated by the two secretariats to facilitate national and local action (UNCCD, 2007).
UNCCD and United Nations Framework Convention on Climate Change (UNFCCC)	Coordination of reporting	Identifies how the development of national adaptation programmes of action under the UNFCCC could take place in close collaboration with UNCCD NAPs.
UNCCD, UNFCCC and CBD	Workshop on Forests and Forest Ecosystems	Encourages (1) the implementation of specific actions at local level relating to forests and forest ecosystems and their use and conservation (derived from the mandates and commitments under each convention); and (2) the further development of synergistic processes in this sector that would contribute to more effective implementation of the Rio conventions.
UNCCD, CBD and UNFCCC	Joint Liaison Group	This informal forum improves the exchange of information, explores opportunities for synergistic activities and increases coordination among the three Conventions and their secretariats for the benefit of their respective Parties (UNFCCC, 2004).
UNCCD, CBD and UNFCCC — with the Global Environment Facility and other partners	Ecosystems and Climate Change Pavilion (also called the Rio Conventions Pavilion)	The Rio convention's Ecosystems and Climate Change Pavilion is a collaborative outreach activity involving the Rio convention secretariats as well as the Global Environment Facility and other partners. The CBD's LifeWeb also plays a key role. The Pavilion is a platform for raising awareness and sharing information about the latest practices and scientific findings on the co-benefits that can be realised through implementation of the three Rio conventions.

5.2.1. A harmonized approach consistent with the 2012–2015 UNCCD secretariat workplan

The demand for further monitoring efforts is echoed in the multi-year (2012–2015) UNCCD secretariat workplan. For instance, one desired programme outcome area is that "National monitoring and vulnerability assessments of biophysical and socioeconomic trends in affected countries are supported" and that "a national and global baseline based on biophysical and socioeconomic trends is developed and relevant scientific approaches are gradually harmonized for assessing progress in meeting strategic objectives 1–3[31]" (UNCCD 2012b). It is furthermore expected that "affected country Parties revise their national action programmes (NAPs) into strategic documents supported by biophysical and socioeconomic baseline information and include them in integrated investment frameworks".

[31] 1) To improve the living conditions of affected populations; 2) To improve the condition of affected ecosystems ; 3) To generate global benefits through effective implementation of the UNCCD.

5.2.2. *UNCCD impact indicators – an important step towards harmonization*

In 2009, UNCCD stakeholders began developing indicators for measuring the strategic objectives of its 10-year strategic plan and framework to enhance the implementation of the Convention (2008–2018) (The Strategy). As such, the UNCCD is the first of the three Rio Conventions to devise a complex impact assessment process. This could provide the other two Rio conventions (UNFCCC and CBD) with some useful pointers for the future (UNCCD news, 2011)[32].

The UNCCD impact indicators serve to assess progress against the Convention's strategic objectives and are part of the performance review and assessment of implementation system (PRAIS).[33] The indicators are meant to enable the Parties to monitor and assess their vulnerability to biophysical and socioeconomic trends in DLDD. By doing so, they can set up realistic targets to combat desertification and land degradation and mitigate the effects of drought.

In 2009, the Conference of the Parties provisionally agreed on a set of eleven impact indicators (decision 17/COP.9). Starting in 2012–2013, affected country Parties to the Convention will at least report on: (a) the proportion of the population in affected areas living above the poverty line; and (b) land cover status (by monitoring land degradation in terms of long-term loss of ecosystem primary productivity, taking into account the effects of rainfall on net primary productivity). Examples of other provisionally recommended impact indicators include: food consumption per capita, water availability per capita, carbon stocks above and below ground, and land under SLM (Schulte-Herbrüggen, et al., 2012). By 2018, UNCCD stakeholders are expected to have gained enough evidence to determine whether land degradation is on the rise or decreasing and at what rate. Decision makers are also expected to have a better understanding of the achievable targets and the levels of degradation they should be prepared to adapt to (UNCCD news, 2011).

5.3. CONCLUDING COMMENTS

There is significant potential for governments and international scientific and technical bodies of the Rio conventions to benefit from joining efforts in knowledge management. Cost-efficient, easily manageable and exchangeable monitoring and assessment systems are vital at various scales of interaction: for land users and local decision makers as well as national and regional planning purposes (Akhatar-Schuster et al., 2010).

Up to now, a lack of effective monitoring and assessments of the state of the land and the performance of interventions has hampered progress in implementing NAPs. This has made it difficult to link remedies to diagnoses. Fortunately, some of these issues are currently being addressed in the development of the UNCCD knowledge management system, the secretariat's multi-year work programme, and the establishment of impact indicators. However, this paper asserts that the latter initiatives should establish harmonized approaches to collecting and storing biophysical and socio-economic data. An enhanced understanding of how land-use interventions affect livelihoods, biodiversity, carbon sequestration and soil fertility will enable improved targeting of financial resources for the three Rio Conventions.

[32] http://newsbox.unccd.int/3.1/.

[33] http://www.unccd.int/en/media-center/Multimedia/VideoGallery/Pages/Performance-review-and-assessment-of-implementation-system-%28PRAIS.aspx.

6. USING THE ECONOMICS OF DESERTIFICATION, LAND DEGRADATION AND DROUGHT TO INFORM POLICIES AT LOCAL, NATIONAL AND INTERNATIONAL LEVEL

There is a widespread consensus that the pressing issues of DLDD are not yet properly and adequately addressed in today's political agenda at global, regional and national level. It is therefore of vital importance to improve current land management practices to reduce land degradation and increase resilience. The following chapter demonstrates how the economics of DLDD may help design effective tools for mitigating or adapting to DLDD. It starts by addressing the shortcomings of actions derived from NAPs and concludes by showing how CBA and green accounting can help provide a roadmap to efficiently and effectively tackle the risks of human-induced land degradation, its potential impacts and options for adaption and mitigation, while drawing on a sound scientific basis.

6.1. ADDRESSING THE ROLE OF INSTITUTIONS AND POLICIES IN IMPLEMENTING NATIONAL ACTION PROGRAMMES

There have been a number of challenges in implementing NAPs. For many years, the most serious constraint was the lack of financial support from international donors and national governments. In particular, because NAPs have often been donor-funded in the past, they have been aligned with 'projects' and donor expectations rather than being integrated with other national policies or country-specific priorities (IFPRID 2011). For instance, NAPs have been criticized for not addressing the fundamental role that institutions and policies play in land management and for not seeking actions to change these (IFPRID, 2011; Akhtar-Schuster et al., 2010). With the GEF serving as the financial mechanism of the UNCCD since 2010, contributing to implementation of the Convention and The Strategy, there is scope for the more effective implementation of the Convention at the national level.[34] Examples are provided below as to how the economics of DLDD may be used to prescribe effective and equitable policies for tackling land degradation and mobilizing resources.

6.2. MAKING USE OF VALUATION TOOLKITS AND GREEN ACCOUNTING IN DECISION-MAKING

Developing a vision of the levels of degradation that a country or region is prepared to mitigate or adapt to depends on the costs and benefits of adaption and mitigation versus inaction. CBA, however, as explained in chapter 2, is best adapted to measuring marginal changes within reasonable geographical bounds, such as hotspots where land degradation and desertification are pressing. At the nation-wide or macro level, green accounting is a superior tool for informed decision-making. Fortunately, much progress is currently being made with respect to developing methodologies that can capture nation-wide ecosystems' changing capacities to provide goods and services to people. Building on chapters 2–5, the following section concludes by making a case for using economic valuation and associated knowledge management systems to inform the design of inequitable and efficient instruments or policies to foster SLM. It also considers the potential for using green accounting to inform decision-making in the context of complex dryland socio-ecological systems.

[34] http://archive.unccd.int/financialMechanisms/menu.php?noMenus=1.

6.2.1. Necessary building blocks

Consensus has emerged that solving problems posed by global environmental change requires coordinated research that pays at least as much attention to the social sciences as it does to natural science (Perrings et al., 2011: 332; Watson 2005; Reynolds et al., 2010). Considering social sciences implies going beyond observing and monitoring elements of biodiversity and soil status (e.g. MA, GEO) by monitoring 'human' drivers of change and how they affect both ecosystems and livelihoods.

With respect to REDD+ project implementation, for instance, socioeconomic assessments may be useful not only as a means to evaluate impacts on livelihoods but also to help understand the root causes of land degradation and deforestation at community level. In practice, not considering or addressing the social dynamics (e.g. land degradation due to poverty) can lead to leakage, conflicts and the volatility of projects (Benessaiah 2012). Moreover, it is important to keep in mind that human needs change over time and that the viability of livelihoods depends upon a range of services. The whole basket of ecosystem services must therefore be considered rather than any single one in isolation (Reynolds 2009). As part of this basket, it is important to monitor longer-term measures of food productivity and household income levels as these provide stable indicators of which regions are becoming more or less resilient to future drought shocks. Hence, the proceedings of the UNCCD 1st Scientific Conference recommended that desertification monitoring should focus on longer-term variables such as income and nutrients in the soil (as opposed to emergency aid monitoring) because slow variables actually control changes of state, while fast variables usually reflect unimportant variability within states (Raynolds 2009).

The call for the more systematic analysis of the costs and benefits of changes in land-use practices and integrated approaches to advancing synergies in the implementation of the Rio Conventions underpins the need for establishing baselines for land degradation, carbon stocks, water extraction rates, poverty rates, etc. This is currently being addressed by developing the UNCCD's impact indicators (chapter 5).

6.2.2. Valuation as a toolkit for responsible private and public sector decision-making

There are far-reaching costs of inappropriate land management. This paper argues that these costs – whether related to losses in productivity, impacts on health, shrinking carbon sinks, damage to infrastructure, loss of biodiversity and genetic resources – should be accounted for in decision-making to ensure optimal and efficient use of scarce resources.

CBA, or rather the valuation of non-market goods and services, is a critical tool to help decide how land, labour and capital should be best allocated. CBA may be undertaken using a few or several of the methods outlined in the valuation toolbox (chapter 2). If the 'net present value' of halting land degradation and desertification are larger in absolute magnitude than inaction, there is a case for ensuring that those that engender land degradation have sufficient incentives, resources and knowledge to change their practices, and potentially enabling off-site beneficiaries to help finance SLM practices.

When financial resources are limited, multiple CBAs assessing space (spatial CBAs) can help prioritize the projects that yield the largest net benefits. Embedded in the application of a comprehensive CBA is also an understanding of how costs and benefits of evaluated land-use scenarios are distributed. This information is relevant in the context of designing equitable policies. Some countries in particular may be interested to know the distributional implications of land use interventions, and pro-poor proponents will want to see that these interventions benefit low-income communities more than mid- to high-income communities.

As the benefits of halting desertification and land degradation accrue at different scales (from local to global) depending on the service provided, there should be different economic instruments for mobilizing resources to tackle DLDD (see chapter 4). However, the costs of ecosystem restoration can be substantial. Typical restoration costs range from USD 100 to 1,000 per hectare, but values vary markedly by ecosystem type, the extent of degradation and the restoration methods used (TEEB, 2009). Until now, very few attempts have been made to conduct a CBA for restoration initiatives. In a review of over 2,000 restoration case studies, TEEB (2009) found that less than 5 per cent provided meaningful cost data, and of those, none provided a detailed analysis of the achieved or projected benefits. There are also major knowledge gaps related to the costs and benefits of various SLM practices and the values/impacts (direct and indirect) of preventing or mitigating degradation and sustaining or enhancing ecosystem services (GEF, 2012b). It is thus difficult to make a convincing case to policymakers on the importance of investing in degradation prevention and SLM promotion. This background paper therefore calls for more systematic research on the economics of tackling land degradation.

In the meantime, there is wide recognition of the importance of SLM and ecosystem restoration for reducing carbon emissions, enhancing soil fertility and countering biodiversity loss (in chapter 5). UNCCD NAPs should thus be implemented and linked whenever possible to CBD National Biodiversity Strategies and Action Plans (NBSAPs) and UNFCCC National Communications.

Economic valuation conducted as part of a rigorous impact evaluation may also help clarify how and to what extent any given land-use practice may contribute to the objectives of the three Rio Conventions. Depending on the goods and services valued, economic valuation can underscore potential trade-offs or synergies between biodiversity, livelihoods and carbon storage associated with changes in land use (Caplow et al., 2011).

New financial resources are more likely to be mobilized if there are measurable objectives and means to evaluate progress towards meeting objectives. Moreover, potential donors may have different minimum requirements that should be accommodated (e.g. pro-poor ecosystem restoration). As such, neglecting how livelihoods are impacted by PES schemes may undermine their legitimacy in the long run (Leimona et al., 2009).

Finally, from the perspective of the corporate sector, improved transparency with respect to the environmental impact of their operations and supply chain may help trigger more responsible management. There are indeed signs of increasing recognition by the private sector that the very fabric of the natural capital that underpins economic prosperity is being undermined. For instance, PPR and its brand Puma recently published the first-ever Environmental Profit and Loss Account (EP&L) demonstrating the economic value of the environmental impact of their operations and supply chain (PPR 2011). Similarly, the Natural Capital Declaration[35], launched at Rio+20, is a statement by the financial sector demonstrating its leadership and commitment to work towards integrating natural capital criteria into financial products and services for the 21st century.

[35] http://www.naturalcapitaldeclaration.org

6.2.2.1. The Economics of Land Degradation initiative (2009–2004)

Launched by the European Commission, the German Government and the secretariat of the UNCCD in 2009, the Economics of Land Degradation (ELD) initiative aims to make economics of land degradation an integral part of policy strategies and decision-making. It has the ambitious vision of creating global awareness on the topic with regard to the market and non-market values for SLM in preventing the loss of natural capital, preserving ecosystem services, combating climate change and addressing food, energy and water security. One component of ELD is also to benefit businesses by identifying business investment opportunities and incentives linked to the preservation and sustainable management of land services and to promote new tools for measuring and reporting on their impacts. In all of these respects, the ELD initiative responds to the needs expressed in this background paper.

6.2.3. Scaling up: natural capital accounting as a tool for designing policies for the mitigation of or adaptation to desertification, land degradation and drought

At macro level, GDP or other conventional macroeconomic indicators do not capture most services provided by the natural environment (e.g. fertile soils). However, given their vital contribution to long-term economic performance and human well-being, they should be treated as economic assets that provide flows of goods and services. Green accounting is an essential component of mainstreaming the value of ecosystems because the maintenance of natural ecosystems requires knowledge on how they can accommodate economic growth. While the system of national accounting is based on aggregate indicators of income, consumption and investments, the System of Environmental-Economic Accounts (SEEA) is the statistical framework that provides accounting rules and standard tables for producing internationally comparable statistics on the environment and its relationship with the economy (UNSTATS, 2012a).

At present, SEEA provides guidance to countries for compiling asset accounts (stocks and changes in the stocks of natural resources such as land, forest, water, fish, soils, minerals and energy in physical and monetary terms), physical flow accounts (for the use of energy, water, other materials, air and water emissions by economic sectors) and monetary accounts (environmental taxes and subsidies, environmental protection expenditure and resource management expenditures) (UNSTATS 2012b). Land degradation for SEEA purposes is measured in terms of physical depletion of natural stocks in the asset accounts. The present accounting system, however, does not fully account for all possible changes, such as when there is a reduction in the quantity of an environmental asset due to unexpected extreme weather events, for example. To fully benefit from SEEA, some harmonization with the UNCCD biophysical indicators framework will most likely be needed.

Of further relevance to addressing land degradation at the national level, the new revision of SEEA (expected by early 2013) includes for the first time a special volume on ecosystem accounts. The motivation for including ecosystem accounts comes from emerging demands for measuring progress in relation to the green economy, green growth and resource efficiency, and the Aichi Targets. In the context of prescribing policies for combating DLDD and mitigating the effects of droughts, SEEA ecosystem accounts can help countries design a management strategy that balances trade-offs among agriculture, subsistence livelihoods, and ecosystem services such as nutrient rich soils and groundwater recharge that may result from SLM. The valuation techniques employed draw on models such as InVest and ARIES to quantify the flow of provisioning and regulating ecosystem services from a specific land-use configuration (WAVES 2012). These services are subsequently valued using market prices and production functions (see appendix).

Although many countries have insufficient statistical capacity to implement SEEA, most have established integrated monitoring systems to support the implementation of the Millennium Development Goals (MDG). One such example is the DevInfo[36] system, which offers uniform and integrated databases for organizing, storing, and disseminating national data from the different government ministries and departments as well as United Nations agencies. The system supports a minimum standard set of indicators including the 48 MDG indicators. Moreover, DevInfo supports an unlimited number of indicators, which are typically identified through a dialogue among the different line ministries and between major users of the system according to specific and emerging needs. As such, the system can be used for the monitoring and valuation of a number of elements relevant for sustainable dryland and drought risk management. DevInfo is fully operational in many dryland countries such as India and Senegal.

Finally, advances in access to high-resolution satellite imagery and remote sensing will also offer increasing opportunities to advance the current state of national green accounting and to include careful consideration of the role of land degradation or conversely SLM as impediments or facilitators of inclusive economic growth, respectively.

6.3. CONCLUDING COMMENTS

For nearly four decades, scientific consensus on the scope of land degradation and its global impact on livelihoods has been elusive. Although countries and experts have been monitoring land degradation, it is not possible as yet to establish rigorous baselines and collectively determine in any systematic manner their impact on economic growth or natural capital wealth. Nonetheless, monetary values are needed for policy because decisions are made on the basis of values, not physical quantities. Although access to quality data is an ongoing challenge for conducting CBAs and pursuing green accounting, this challenge should be pursued, to ensure that distortive activities are halted and investments are directed to where they yield the highest net-benefits to society.

Finally, in not undermining the importance of tackling policies or institutional factors that contribute to unsustainable land management practices, it is important to address these independently of efforts to account for natural capital and ecosystem valuation. If ecosystem mismanagement is associated with a lack of awareness or information about land-use practices that are in the private landowner’s own financial interest to adopt, then education and awareness building are appropriate responses, not market-based instruments. Similarly, if capital market imperfections prevent landholders from adapting privately profitable technologies or practices that enhance ecosystem service provision, then providing access to credit is the most promising approach (Engel et al., 2008).

[36] www.devinfo.org

7. CONCLUSION

DLDD has wide-ranging impacts on livelihoods, ecosystem health and integrity. Desertification and land degradation limits land productivity and its ability to provide ecosystem services at local, national and regional scales. This is manifested in the loss of fertility and nutrients, carbon sequestration, wood production, grazing and hunting opportunities, nature conservation and tourism – all factors that directly impact the economies affected by land degradation. There are also significant off-site impacts from DLDD, which include dust storms, dryland salinity, changes in stream flow, reliability of irrigation, water flow, a decline in quality of drinking water, and the silting of rivers, lakes, reefs systems and dams. It is arguably now more important than ever to build resilience to DLDD. With projected global temperature increases, extreme events could occur more frequently in a globally synchronized way (World Bank 2012). For instance, if three large areas of the world are simultaneously adversely affected by drought, there is a growing risk that global agricultural production may not be able to compensate for regional droughts as it has in the past (Dai 2012).

Decision makers can choose to take action to control the causes, level or effects of degradation. The level of land degradation determines its effects on the provision of ecosystem services and the benefits humans derive from those services. As highlighted above, many of the services provided by healthy ecosystems or SLM are not traded on the market and therefore have no explicit price. This leads to the undervaluation of the land and its provision of ecosystem services. CBAs offer the means to correct such information deficiencies.

Until now, most work on the economics of DLDD has focused on declines in the services provided by affected ecosystems, i.e. the direct costs of declining productivity in crop or livestock production systems. The full impact of DLDD on ecosystems, however, goes beyond the services provided to affecting regulating and cultural services. These should be accounted for in any comprehensive CBA in order to design sound policy instruments. To achieve further progress in this direction, a toolbox is presented in chapter 2 that links economic valuation methods to the most pressing impacts of land degradation so as to help decision makers consider land-use trade-offs in monetary terms.

Chapter 3 described SLM and ecosystem restoration as resilience-building activities that can help break the downward spiral of desertification and land degradation. Public policy instruments for sustainable land use may be of a regulatory, economic or advisory nature (OECD, 1994). Advisory approaches include education and awareness-building, which may be used if, for example, ecosystem mismanagement is associated with a lack of awareness or information on land-use practices that are in the private landowner's own financial interest (Engel et al., 2008). Regulatory approaches should consider reforms that address tenure security, imperfect capital markets, and capacity-building to implement SLM at local, sub-regional, regional and national levels. Economic approaches serve to create incentives by removing capital market imperfections and creating markets for SLM. For instance, if capital market imperfections prevent landholders from adapting privately profitable technologies or practices that enhance the provision of ecosystem services, access to credit should be advocated. When an individual landowner does not have a personal incentive for adopting SLM, economic approaches may be used to create markets for the services delivered through SLM. Environmental markets, also called PES mechanisms, are emerging in many countries and also at international level (carbon, water, biodiversity markets).

As shown in chapter 4, the basic idea of a market-based approach to promote SLM is that those entities that provide benefits by lowering, for example, the off-site impacts of land degradation, should be compensated for their efforts, while those that engender land degradation or damage soil productivity must pay the costs either to those directly affected or to the state who will act on their behalf. CBA plays a pivotal role in the design of market-based instruments. Regardless of who eventually mobilizes the necessary resources (beneficiary, polluter, local, national or international institution or authority), economic valuation also fosters more restoration or sustainable land-use practices for any given budget by defining cost-benefit ratios for any number of land-use scenarios. Lastly, by accounting for changes in a wide range of ecosystem services, CBAs may help clarify how and to what extent a certain land-use practice contributes to the objectives of the CBD, UNFCCC and UNCCD.

Climate change, land degradation and biodiversity loss share the same underlying causes. All three processes are the result of combined market, information and policy failures. Market failures arise because the respective agents and actors who contribute to the problems of biodiversity loss, climate change, and DLDD do not bear the costs incurred off-site by agents external to their decision-making. In the same sense, those that contribute to halting biodiversity loss, climate change or DLDD are not compensated for their undertakings when the markets are left to their own devices. The three Rio Conventions thus share synergies in possible policy responses (i.e. correction for market failures). They also share synergies in practical responses. ZNLD for instance could precipitate multiple global benefits in terms of biodiversity conservation, carbon storage, agricultural productivity, and poverty reduction. In a similar sense, carbon finance has the potential to both reduce desertification and restore or conserve millions of hectares of threatened, biodiversity-rich habitats around the world. But before carbon finance projects, or more generally PES measures, can be fully operational, there needs to be an internationally accepted standard for determining and evaluating the multiple benefits of PES projects across the three Conventions.

In chapter 5, the need to establish national clearing houses and an international knowledge management systems that have the capacity to assemble, organize and share data so as to avoid expensive duplication of efforts across the three Rio conventions were addressed, particularly the enhanced integration of monitoring activities and the implementation of socioeconomic assessments (such as CBA). Lack of integration of monitoring and assessment activities manifests itself when those working at the national and international levels are unable to tap into the data and expertise of those who manage the land, who in turn never see the benefits of national, regional or international monitoring programmes (Reed et al., 2006).

In chapter 5, a desired outcome area within The Strategy is that “National monitoring and vulnerability assessments of biophysical and socio-economic trends in affected countries are supported” and that “a national and global baseline based to biophysical and socio-economic trends is developed”. In this regard, the UNCCD is in the process of devising an impact assessment process which will enable Parties to monitor and assess their vulnerability to biophysical and socio-economic DLDD trends. By 2018, UNCCD stakeholders should have enough evidence to determine whether land degradation is on the rise or decrease and at what rate. Such impact indicators will also be able to provide the other two Rio Conventions with some useful pointers in future (UNCCD 2011[37]).

These latter initiatives are in line with the recommendations of this paper, which insist on establishing harmonized approaches to collecting and storing data. Chapter 6 concluded the background paper by showing why baseline biophysical and socio-economic data are valuable as means to advance green accounting and mainstream CBAs for SLM as a tool to handle land degradation. Mainstreaming and scaling-up CBA requires at the very least access to a solid data

[37] http://newsbox.unccd.int/3.1/

foundation based on biophysical parameters. Second, mobilising funding and increasing confidence in ecosystem investment requires clear, measurable objectives and means to evaluate progress toward meeting objectives. Third, at macro level, regular monitoring to trace the flow of ecosystem goods and services may be used to advance national green accounting, which can help countries design a management strategy that, for example, balances trade-offs among agriculture, forestry, mining, nutrient-rich soils and groundwater recharge.

Such advances have already been made. The ELD initiative, for instance, seeks to collect data, provide for concise methodologies on valuation and raise awareness about the economic dimensions of land degradation. By making a clear case of how to improve decision-making tools, it is hoped that this paper may fuel progress towards scaling up efforts to combat DLDD through improved measurement and monitoring, assessments, evaluations, scenario-building and policy advice.

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APPENDIX: VALUATION METHODS PRESENTED IN THE TOOLBOX

Group	Methods	Summary of what they involve
Direct market prices	Adjusted market prices	Observing market prices and adjusting them for taxes, subsidies, seasonal variations, etc.
Cost-based approaches	Replacement costs	Estimating the expense of replacing an ecosystem service with a man-made product, infrastructure or technology. This technique requires direct observation and expert consultations and estimates, but is typically relatively straightforward to calculate.
	Damage cost avoided	Determining how much spending was avoided because of the ecosystem service provided by protecting other assets such as hydropower works, agricultural and human settlements. Data collection can be difficult due to the need to estimate hypothetical damages.
	Mitigative/ avertive expenditure	Employed when the decline or loss of a service would require resources to be expended to counteract the negative impacts of the degraded/missing service in order to avoid economic losses, e.g. determining the value (opportunity cost) of the additional time that has to be spent to collect water. This technique requires direct observation and expert consultations and estimates.
	Production function-based approach	Determining the value of an ecosystem service by considering its role in the production of other goods and services that are marketed, i.e. how much value-added can be attributed to the input of the ecosystem services into the production process of the marketed good. This technique requires quantifying the biophysical relationship between the ecosystem service and the end product.
Surrogate markets	Hedonic price method	The basic premise of the hedonic pricing method is that the price of a marketed good is related to its characteristics or the services it provides. You estimate the value of an environmental amenity or disamenity by comparing (through regression analysis) the price of a good, e.g. a hotel room with a view over a lake, to that of a similar hotel room without a view over a lake. Regression analysis allows for the isolation of independent explanatory variables that impact the price of the good under consideration.
	Travel cost method	Considering the costs involved in travelling to a certain site as a proxy of the recreational value of the site. Costs typically include forgone wage earnings and transportation costs.
Stated preference	Contingent valuation method	Quantifying the value of non-marketed ecosystem services by asking individuals directly about their willingness-to-pay for a specific service or their willingness to accept compensation for the loss of a service.
	Choice experiments	Same as above except that individuals are given a ‘menu’ of options with differing levels of ecosystem services and differing costs. They are asked to choose which scenario is preferred.

Group	Methods	Summary of what they involve
Other methods for analysing health issues	Value of statistical life (VSL) Cost of Illness (COI) Disability-adjusted life year (DALY)	**VSL:** discounted present value of future earnings **COI:** Estimates the societal impact of disease and injury by combining 'direct costs' (medical care, travel costs, etc.),mortality in the population and the years lost due to disability (YLD) for incident cases of the health condition. Years of life lost (YLL) are calculated from the number of deaths at each age multiplied by a global standard life expectancy of the 'indirect costs' (the value of lost production because of reduced working time) into an overall estimate of economic impact on society, often expressed as a percentage of current gross domestic product. **DALYs:** DALYs for a disease or health condition are calculated as the sum of YLLs due to the premature age at which death occurs. YLDs for a particular cause and a particular time period are estimated as follows: YLD = number of incident cases in that period × average duration of the disease × disability weight. The disability weight reflects the severity of the disease on a scale from 0 (perfect health) to 1 (death). The disability weights used to determine the global burden of disease DALY estimates are listed elsewhere.

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Pablo Olivieri (Trees in the wind)
Giulio Napolitano (Cattle walking to the well)
Arup Halder (Children transporting water)
Dibyendu Dey Choudhury (Women transporting water)

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