



# 71

## VALUING THE BIODIVERSITY OF DRY AND SUB-HUMID LANDS



Convention on  
Biological Diversity





**CBD Technical Series No. 71**

# **Valuing the Biodiversity of Dry and Sub-Humid Lands**

A peer-reviewed report commissioned to the Global Mechanism of the United Nations Convention to Combat Desertification and prepared in collaboration with the OSLO consortium

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For further information, please contact:

Secretariat of the Convention on Biological Diversity  
World Trade Centre  
413 St. Jacques Street, Suite 800  
Montreal, Quebec, Canada H2Y 1N9  
Phone: 1(514) 288 2220  
Fax: 1 (514) 288 6588  
E-mail: [secretariat@cbd.int](mailto:secretariat@cbd.int)  
Website: <http://www.cbd.int>

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## FOREWORD

Dry and sub-humid lands, or drylands, cover over 40 percent of the Earth's land surface and are home to about a third of the world's population. Most of this vibrant population reside in developing countries. Despite their high level of aridity, drylands contain a great variety of plants and animals, and include important areas of extraordinary endemism. Nowhere is soil biodiversity, our invisible life supporting system, as crucial as in drylands. In fact, aridity contributes to the exceptional biodiversity of drylands. Species have adapted in many unique ways creating diverse habitats that are essential both to their own survival as well as to the livelihoods of entire communities.

Drylands are also the original source of many of the world's food crops and livestock. The ecosystem services provided by drylands have great economic, social and cultural value. These services are critical for the rural poor who rely on healthy and productive land as their most crucial asset, supporting all economic activity and closely tied with social and cultural identity. The conservation, restoration and sustainable use of biodiversity in drylands is, therefore, central to improving livelihoods and human well-being, poverty alleviation and sustainable development. Drylands biodiversity is essential to real change in the human condition.

Despite this importance of dryland biodiversity, its true value is not widely appreciated or well understood. The Conference of the Parties to the Convention on Biological Diversity (CBD), at its tenth meeting, recognized this gap and requested the Executive Secretary to publish, in collaboration with the Secretariat of the United Nations Convention to Combat Desertification (UNCCD), a CBD Technical Series report on the value of dry and sub-humid lands, taking into account the role of pastoralists and other indigenous and local communities in the conservation and sustainable use of the biodiversity of dry and sub-humid lands and their associated traditional knowledge (decision X/35).

In response to this request, the present report was developed under the supervision of the Global Mechanism of the UNCCD, in collaboration with the OSLO consortium and the CBD Secretariat. The report provides policy-relevant information on valuation methods in the drylands context and guidance for their use. While valuing biodiversity and ecosystem services may be a complex process, involving all relevant stakeholders from the start ensures higher success rates and leads to the scaling up of sustainable land management policy and practice.

We are pleased to present the result of this collaboration between the CBD and UNCCD, and hope that this publication will support practitioners and policymakers in making more informed decisions related to biodiversity and ecosystem management in the drylands.



Braulio Ferreira de Souza Dias  
Executive Secretary  
Convention on Biological Diversity



Luc Gnacadja  
Executive Secretary  
United Nations Convention to Combat Desertification

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1 <http://www.global-mechanism.org>.

2 <http://www.theoslo.net>.

3 Lead author: Ph.D. Environmental Studies (Environmental economics and policy); M.A. Environmental policy; B.A. Geography and Economics.

4 Lead Reviewer and Technical Editor: Ph.D. Sustainable Development; M.Sc. Conservation Biology; B.Sc. Environmental Science and Agricultural Ecology.

5 Managing Editor and Project Coordinator: M.A. International and Area Studies; M.J.; B.A. Political Science.

## LIST OF ACRONYMS

CAV	change in asset value
CBA	cost-benefit analysis
CBD	Convention on Biological Diversity
CEA	cost-effectiveness analysis
CM	choice modelling
CVM	contingent valuation method
EVL	Economic Valuation of Land
EVRI	Environmental Valuation Reference Inventory
FAO	Food and Agriculture Organization of the United Nations
GM	Global Mechanism
HEA	habitat equivalency analysis
ICRAF	World Agroforestry Centre
IFAD	International Fund for Agricultural Development
IGAD	Intergovernmental Authority on Development
ILO	International Labour Organization
IPA	Integrated Policy Assessment
IUCN	International Union for Conservation of Nature
LPP	League for Pastoral Peoples
MA	Millennium Ecosystem Assessment
MCA	multi-criteria analysis
MEA	multilateral environmental agreement
MTFF	medium term fiscal framework
NDP	National Development Plan
NGO	Non-governmental organization
NTFP	non-timber forest product
NWFP	non-wood forest product
OSLO	Offering Sustainable Land-use Options
PES	payments for ecosystem services
PRSP	Poverty Reduction Strategy Paper
TEEB	The Economics of Ecosystems and Biodiversity
TEV	total economic value
UNCCD	United Nations Convention to Combat Desertification
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
WCS	Wildlife Conservation Society
WHS	World Heritage Site
WISP	World Initiative for Sustainable Pastoralism
WRI	World Resources Institute
WTA	willingness to accept
WTP	willingness to pay

## GLOSSARY<sup>6</sup>

**Arid, semi-arid and dry-sub-humid areas:** Areas, other than polar and sub-polar regions, in which the ratio of annual precipitation to potential evapotranspiration falls within the range from 0.05 to 0.65.

**Benefits transfer:** A method of economic valuation that estimates economic values for ecosystem services by transferring results from valuation studies completed in other contexts.

**Biodiversity** (biological diversity): The variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are a part. This includes diversity within species, between species, and of ecosystems.

**Change in asset value:** Equal to the difference between the value of future services before and after the change.

**Choice modelling:** A stated preference approach that allows the capture of trade-offs between different ecosystem services. Attempts to model the decision process of an individual in a given context given two or more alternatives with shared but different attributes, with a price factor being one of the attributes.

**Commodification of nature:** Assigning a price and organizing market-based transactions of elements of nature.

**Contingent valuation method:** A commonly used stated preference technique that uses questionnaires to ask people how much they would be willing to pay to avoid the loss or increase the provision of an ecosystem service; or, alternatively, how much they would be willing to accept to forgo or lose the service. Examples include willingness to pay for conservation of unique flora species, or international values for the existence of Namibian wildlife.

**Cost-based approaches:** Market valuation methods that approximate the value of biodiversity/ecosystem services by calculating the costs resulting from a certain course of action that would lead to their decline, for instance in terms of replacement or restoration costs.

**Cultural services:** The non-material benefits obtained from ecosystems.

**Direct use value:** (1) Consumptive direct use value is the value that people derive from actual consumption of goods extracted from ecosystems (e.g. water, fish, wood directly); (2) Non-consumptive direct use value is the value that people derive from interaction with natural systems through recreation or spiritual/cultural gateways, or the educational and scientific knowledge of ecosystems.

**Dryland:** Area with an aridity index value of less than 0.65, meaning annual precipitation is less than about two-thirds of potential evapotranspiration.

**Ecosystem:** A dynamic complex of plant, animal and microorganism communities and their non-living environment interacting as a functional unit.

**Ecosystem services:** The benefits that people obtain from ecosystems.

**Green economy:** An economy that results in improved human well-being and social equity while significantly reducing environmental risks and ecological scarcities.

**Group valuation:** Combines stated preference techniques with elements of deliberative processes from political science to capture value types that may escape individual based surveys.

**Hedonic pricing:** A revealed preference approach that seeks to isolate the willingness to pay for ecosystem services from the prices for associated goods, building on the fact that the willingness to pay for some ecosystem services will already be reflected in the prices for such goods.

**Indirect use value:** The benefits that people derive indirectly from the ecological functioning of ecosystems, including water regulation and purification, soil formation and nutrient cycling, and carbon sequestration. Ecological

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6 Glossary definitions derive from the following sources: CBD, IFAD, Millennium Ecosystem Assessment, UNCCD, and UNEP.

functions are positive externalities as they are the product of natural systems which are not or can not be privately owned and for which we do not pay the full cost of production/value of provision.

**Market failure:** The inability of a market when left alone to capture so-called external costs or benefits.

**Market-based approaches:** Methods that estimate the value of an ecosystem as equivalent to its ecological yield using local or global commodity markets prices, value of labour employed, asset valuations (e.g. value of livestock herds, value of dryland product exports).

**Natural capital:** A society's natural capital is its living and non-living resources; these can be renewable, non-renewable or cultivated. Natural capital resources comprise the stocks from which environmental goods and services flow to economic production.

**Net present value:** Equal to the sum of discounted annual net values.

**Non-use value:** The value of knowing that an ecosystem or species continues to exist without ever interacting with it (**existence value**); the value of knowing that while you will not benefit directly from an ecosystem, others will (**altruistic value**); the value of knowing that ecosystems will benefit future generations (**bequest value**).

**Option value:** The value of retaining the possibility of using resources in the future, even if the benefits are unknown.

**Pastoralists:** People who derive more than 50 percent of their incomes from livestock and livestock products (as distinct from agropastoralists, who derive less than 50 percent of their incomes from livestock and livestock products, and most of the remaining income from cultivation).

**Production function (or change-of-productivity) approaches:** Methods that estimate how much a given biodiversity asset or ecosystem service (e.g. regulating service) contributes to the delivery of another service or commodity which is traded on an existing market.

**Provisioning services:** The goods or products obtained from ecosystems.

**Regulating services:** The benefits obtained from an ecosystem's control of natural processes.

**Revealed preference approaches:** Methods using observation of individual choices (or willingness to pay) in existing markets that are related to the ecosystem service that is subject of valuation.

**Stated preference approaches:** Methods that simulate a market and demand for ecosystem services by means of surveys on hypothetical (policy-induced) changes in the provision of ecosystem services.

**Stock and flow:** "Stock" refers to the total merchandise kept on hand by a merchant; "flow" means the quantity of goods sold by a manufacturer.

**Supporting services:** Ecosystem services supporting the provision of other services.

**Total economic value:** The sum of all benefits, monetary or other, obtained from a resource: use value (direct and indirect) + option value + non-use value (bequest + altruistic + existence value).

**Trade-off analysis:** To evaluate effects (costs and benefits) of alternative development options for a given area, for instance, in order to make informed decisions about possibilities (and impossibilities) for sustainable, multi-functional use of its services.

**Travel cost method:** A method, used where use of ecosystem services may require travel, that sees travel costs as a reflection of the implied value of the service.

**Valuation:** The process of expressing a value for a particular good or service, usually in terms of something that can be counted, often money, but also through methods and measures from other disciplines (sociology, ecology, etc.).

**Value:** The contribution of an action or object to user-specified goals, objectives or conditions.

**Well-being:** Human well-being has multiple constituents, including the basic materials for a good life, health, good social relations, and freedom of choice and action. Together these factors provide the conditions for physical, social, psychological and spiritual fulfillment. The conceptual framework for the Millennium Ecosystem Assessment posits that because people are integral parts of ecosystems, changes in human conditions are one factor that drive changes in ecosystems and thereby cause changes in human well-being.

**Willingness to pay:** The maximum amount an individual is willing to pay, sacrifice or exchange in order to receive a good or service. A related concept is willingness to accept, which is which is the minimum amount an individual is willing to receive in order to give up a good or service.

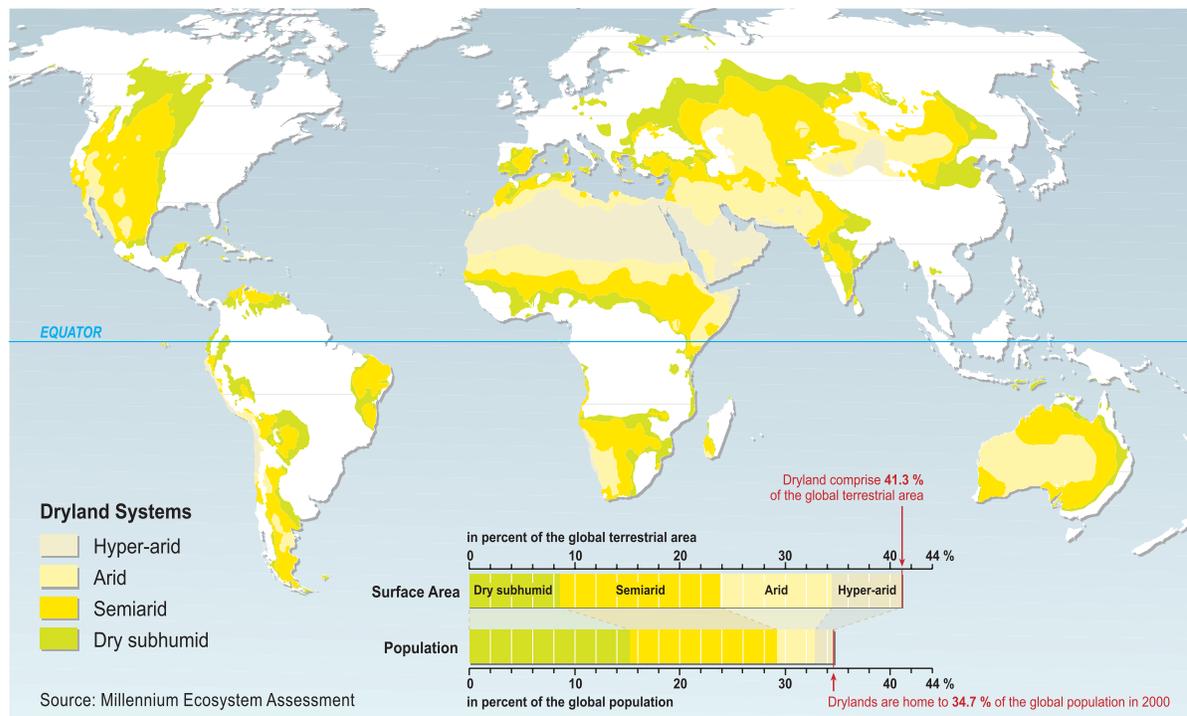
## 1. INTRODUCTION

The tenth meeting of the Conference of Parties to the Convention on Biological Diversity (CBD), held in Nagoya, Japan in October 2010, adopted a comprehensive decision on the biodiversity of dry and sub-humid lands (decision X/35).<sup>7</sup> The decision called for the publication of a peer-reviewed special CBD Technical Series report, in collaboration with the United Nations Convention to Combat Desertification (UNCCD), on the value of dry and sub-humid lands,<sup>8</sup> taking into account the traditional knowledge of pastoralist and other indigenous and local communities and their role in the conservation and sustainable use of dryland biodiversity. This report was developed under the supervision of the Global Mechanism,<sup>9</sup> a subsidiary body of the UNCCD. It will be used by practitioners and policymakers to enable more informed decision-making on these subjects.

### 1.1. BIODIVERSITY AND ECOSYSTEM SERVICES IN DRYLAND REGIONS

Dry and sub-humid lands, or drylands, are characterized by water scarcity, seasonal climatic extremes and unpredictable rainfall patterns. They cover over 40 percent of the Earth's land surface and are home to about a third of the world's population<sup>10</sup> (see Figure 1 for map, and Box 1 for more facts about drylands).

**Figure 1:** Map of global drylands. (Source: Millennium Ecosystem Assessment)



7 CBD Secretariat, 2010.

8 Drylands appear to be relatively underrepresented in the literature on valuation work, compared to rainforests or wetlands, for instance, according to the literature review conducted by the authors.

9 [www.global-mechanism.org](http://www.global-mechanism.org).

10 See Safriel *et al.*, 2005, p. 626.

**Box 1: Dryland facts**

Drawing on data from the World Atlas of Desertification, the Millennium Ecosystem Assessment defines drylands as areas with an aridity index value of less than 0.65, meaning that annual precipitation is less than about two-thirds of potential evapotranspiration ( $P/PET < 0.65$ ). Similarly, Davies *et al.* (2012), consider drylands to be areas where the potential amount of water that is transferred from the land to the atmosphere is at least 1.5 times greater than the mean precipitation. The UNCCD delineation excludes hyper-arid zones ( $P/PET < 0.05$ ), since desertification refers to land degradation in arid, semi-arid, and dry subhumid areas.

In 2000, the Conference of the Parties to the CBD established a programme of work on the biological diversity of dryland, Mediterranean, arid, semi-arid, grassland, and savannah ecosystems, noting that this could also be known as the programme on “dry and sub-humid lands” and bearing in mind the close linkages between poverty and loss of biological diversity in these areas (decision V/23). In 2008, the Conference of the Parties adopted a delineation of the areas that the programme of work on dry and sub-humid lands under the CBD should include (annex to decision IX/17), and in 2010, in decision X/35, it adopted a revised delineation (annex to document UNEP/CBD/COP/10/20). The CBD delineation includes hyper-arid zones, unlike the UNCCD’s, and it includes some areas with presumed dryland features but  $P/PET > 0.65$ .<sup>11</sup>

**Key drylands facts:**

- *Drylands include four distinct subtypes, classified according to their **aridity index** (the ratio of precipitation to potential evapotranspiration, P/PET):*
  - **Hyper-arid**,  $P/PET < 0.05$ ;
  - **Arid**,  $P/PET 0.05 - 0.20$ ;
  - **Semi-arid**,  $P/PET 0.20 - 0.50$ ;
  - **Dry sub-humid**,  $P/PET 0.50 - 0.65$ .
- The UNCCD excludes deserts from the definition of drylands when used in the context of sustainable development.
- *Drylands are also described using land cover (e.g. grassland, desert, forest) or land uses (e.g. rangeland, cropland).*
- *The total population of the world’s drylands is about 2 billion.*
- *The UNCCD website notes that:*
  - *Drylands support 50% of the world’s livestock;*
  - *Drylands comprise 44% of all cultivated land;*
  - *Drylands store 46% of the planet’s carbon inventory;*
  - *Plant species endemic to the drylands make up 30% of the plants under cultivation today.*
- *The largest drylands areas in the arid, semi-arid or sub-humid categories are found in Australia, China, Russia, the USA and Kazakhstan, and at least 99% of the surface area of several countries – Botswana, Burkina Faso, Iraq, Kazakhstan, Moldova and Turkmenistan – are drylands; several additional countries have large areas in hyper-arid zones.*
- *Drylands include some major cities.*
- *The majority of the world’s dryland population is in developing countries.*
- *Dryland populations fall far behind the rest of the world on human well-being and development indicators.*

Sources: UNCCD website: <<http://www.unccd.int/en/resources/Library/Pages/Fact.aspx>>; Safriel *et al.*, 2005; Millennium Ecosystem Assessment, 2003; Davies *et al.*, 2012; United Nations Environment Management Group 2011.

11 Maps showing the CBD and UNCCD delineations, respectively, are provided in annex 2 below.

**Box 2: Definitions and explanations: Biodiversity, ecosystems and ecosystem services**

**Biodiversity:** The variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes, which they are a part. This includes diversity within species, between species, and of ecosystems.

**Ecosystem:** A dynamic complex of plant, animal and microorganism communities and their non-living environment interacting as a functional unit.

**Ecosystem services:** The benefits that people obtain from ecosystems. Although *goods, services* and *cultural services* are often treated separately for ease of understanding, the Millennium Ecosystem Assessment considers all these benefits together as “ecosystem services”.

***Drylands biodiversity and its importance***

According to a recent report on *Conserving Dryland Biodiversity* (Davies *et al.*, 2012), drylands contain a great variety of biodiversity, despite their relatively high levels of aridity (see Box 4 for definitions of biodiversity and other key terms). Much of this biodiversity is highly adapted to dryland ecology.<sup>12</sup> A number of animal and plant species, as well as different types of ecosystems (e.g. saline desert), are found only in drylands, and some semi-arid and dry sub-humid areas are among the most biodiverse<sup>13</sup> and productive regions in the world. About 30 percent of the total area of sites of important biodiversity and 28 percent of the total area of World Heritage Sites (WHS) fall within drylands.<sup>14</sup>

The ecosystem services provided by dryland biodiversity have great economic, social and cultural value for both local and global resource users. Local beneficiaries include local rural and indigenous communities and downstream urban populations. Global beneficiaries include multinational businesses with supply chains rooted in food and genetic resources, medicinal plants and cosmetics ingredients, as well as populations benefiting from global climate regulation.

In many developing countries, drylands biodiversity contributes to the well-being of millions of people, playing a vital role in sustaining local livelihoods and food production. Drylands biodiversity provides local populations with food, nutrition, water, and fuel, as well as cultural and spiritual benefits. It also plays a central role in food production, risk management strategies, and a variety of other ecosystem services, including soil maintenance. On a global level, as climate change is anticipated to drive extinctions of wild breeds of flora and fauna and demand for new adaptations, drylands contain what will be an increasingly important genetic reservoir.<sup>15</sup>

Conservation and sustainable management of drylands biodiversity thus offer a viable pathway for working to meet international targets for both conservation and development, including targets of major multilateral environmental agreements (MEAs) related to biodiversity.<sup>16</sup>

***Current trends***

Davies *et al.* (2012) report that while indicators for dryland biodiversity quality are poorly developed, many of the drivers of biodiversity loss are present in drylands – for example, expansion of cultivated and urbanized land uses and unsustainable water abstraction. Conservation International suggests that between 10 and 20 percent of drylands globally may be degraded. This is mainly as a result of increased susceptibility to water and wind erosion

12 See Safriel *et al.*, 2005; Davies *et al.*, 2012.

13 Davies *et al.*, 2012.

14 *Ibid.*, p. 12.

15 *Ibid.*, p. 3.

16 These include the Convention on Biological Diversity (CBD), the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), and the Convention on the Conservation of Migratory Species of Wild Animals (CMS).

following the loss of vegetation cover and diversity. Drylands are also home to 35 percent of global hotspot areas,<sup>17</sup> which contain high numbers of endemic species but have already lost a majority of their original natural vegetation.<sup>18</sup> Also, in many drylands, crop wild relatives<sup>19</sup> are declining, and research shows that levels of protection in centres of crop diversity<sup>20</sup> are considerably lower than the global average.<sup>21</sup>

Predicted likely trends for the future of drylands, particularly as a result of climate change, land-use developments and land-use cover changes, include:

- Accelerated water decline;
- Reduced productivity of croplands;
- Increased habitat loss and fragmentation; and
- Adverse impacts on human well-being through increased resource scarcity.<sup>22</sup>

In this context, it is essential to increase the profile of economic valuation of drylands in research and policymaking in order to enhance the future conservation and sustainability of these lands.

## 1.2. QUESTIONS ADDRESSED IN THIS REPORT

A review of the current available literature on drylands suggests that the value of biodiversity in dryland ecosystems is typically not well recognized and understood. The existing body of information on the value of biodiversity in drylands is relatively small. As a result, government planners often lack the strategic information needed to include the subject in development decision-making and execution, and these values are not captured in national accounts. In some cases the values of the biodiversity of dryland ecosystems come to mean something to policymakers only after catastrophic events like drought or famine.

In this context, there is a need for good quality studies of biodiversity values in dryland regions that qualify the links between biodiversity, ecosystem service production and human well-being; quantify or scientifically measure these interactions; and, when appropriate, monetize the costs and benefits of changes in biodiversity quality. This technical report aims to provide guidance for a broad audience ranging from practitioners to policymakers, drawing on the wide body of information available on biodiversity valuation more generally as well as information on drylands more specifically.

For practitioners, the report provides explanations of biodiversity valuation techniques and how these can be utilized to generate economic data in dry and sub-humid lands (section 3). It includes references to other resources to assist in the development and implementation of studies.

For policymakers, the report demonstrates how the results of valuation may be applied in policymaking (section 4), and how they can assist in making more informed decisions related to dryland environments.

This report complements other documents crafted under the CBD (e.g. see Box 3), as well as the ongoing work on the Economic Valuation of Land (EVL) by the OSLO consortium and work on the Economics of Land Degradation under the UNCCD. The Global Mechanism of the UNCCD was commissioned by the CBD Secretariat to carry out the study, based on its role in leading the OSLO consortium. The report was initially built from the authors' review of the subject matter, methods and results of close to 100 studies directly relevant to biodiversity valuation in dry and sub-humid lands contexts<sup>23</sup> and *The Economics of Ecosystems and Biodiversity* (TEEB) series.

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17 Data originally from the Conservation International Database 2004 and World Database on Protected Areas 2012, cited in Davies *et al.*, 2012.

18 Davies *et al.*, 2012, p. 12.

19 Crop wild relatives refers to plants which may be wild ancestors of a domesticated crop.

20 Centre of crop diversity refers to the geographic region in which the greatest variability of a crop occurs.

21 Stolton *et al.*, 2008.

22 Safriel *et al.*, 2005, p. 625; Davies *et al.*, 2012, p. 4.

23 To support the development of the technical report, a literature review of economic valuation methodologies was conducted. Case studies of economic valuations of biodiversity and biodiversity-based livelihoods carried out in dry and sub-humid lands were collected and particular attention was given to methods relevant to biodiversity within the context of pastoral, indigenous and local communities. The literature review will be posted on the website of the OSLO consortium, [www.theoslo.net](http://www.theoslo.net).

**Box 3: Some related CBD documents and links**

<http://www.cbd.int/incentives/tools.shtml> - e.g.:

CBD Technical Series No. 28. *An exploration of tools and methodologies for valuation of biodiversity and biodiversity resources and functions* (2007); No. 27. *Valuing wetlands* (2006); No. 4. *The value of forest ecosystems* (2001)

Summary poster: *Options for the Applications of Tools for Valuation of Biodiversity and Biodiversity Resources and Functions* (2007, available in English, French, Spanish, Arabic, Russian and Chinese)

<http://www.cbd.int/programmes/socio-eco/incentives/valuation-info.shtml> (Economics, Trade and Incentive Measures Valuation) – links to reference manuals, toolkits, general and country-specific documents

<http://www.cbd.int/drylands/> - e.g. Good Practice Guide: Pastoralism, Nature Conservation and Development

**1.3. VALUATION: WHY AND HOW?**

Natural capital contributes to human well-being by supporting the flow of valuable ecosystem services to both local and non-local<sup>24</sup> populations (see Box 4). Biodiversity is an essential part of this natural capital. However, the standard paradigm has been that loss of natural capital is an inevitable and justifiable cost of economic development, and that trade-offs must be made between natural capital and financial or manufactured capital.<sup>25</sup>

**Box 4: Definitions and explanations: Natural capital, valuation, and human well-being**

**Natural capital:** A society's natural capital is its living and non-living resources. Natural capital resources can be renewable (e.g. living species, biodiverse ecosystems, potable water, fertile soils), non-renewable (e.g. petroleum), and cultivated (e.g. crops and forest plantations), and comprise the *stocks* from which environmental goods and services *flow* to economic production.

**Valuation:** The process of expressing a value for a particular good or service in a certain context (e.g. of decision-making), usually in terms of something that can be counted, often money, but also through methods and measures from other disciplines (sociology, ecology, etc.)

**Well-being:** Human well-being has multiple constituents, including the basic materials for a good life, health, good social relations, and freedom of choice and action. Together these factors provide the conditions for physical, social, psychological and spiritual fulfillment. The conceptual framework for the Millennium Ecosystem Assessment posits that because people are integral parts of ecosystems, changes in human conditions are one factor that drive changes in ecosystems and thereby cause changes in human well-being.

The default scale for measuring and comparing outcomes (net benefits) from different allocations of capital is financial. This is understandable, given that monetary gains are an important aspect of securing human well-being. The returns to investments in maintaining or improving natural (and social) capital are not always easy to

24 By non-local we mean national, regional and international, global etc.

25 Pearce and Turner, 1990; Sterner, 2003.

measure, especially over long-term horizons and across populations and even species, and benefits are not easily demonstrated and captured on this financial scale.<sup>26</sup>

Nature's "economic invisibility"<sup>27</sup> has meant that investments in maintaining biodiversity, for example, have consistently appeared less worthwhile for society than, say, expanding unsustainable agricultural land use. This situation is termed *market failure* – the lack of price signals for uncompensated, harmful impacts on natural capital endowments (*negative externalities*) or for good but unrewarded outcomes from maintaining biodiversity and ecosystem services (*positive externalities*). It explains in part why natural capital degradation occurs: those causing the degradation typically do not pay the full price of their actions, and those "supplying" biodiversity and ecosystem services are often not rewarded for doing so.<sup>28</sup>

An economic perspective on the problem of biodiversity and ecosystem service loss points to a need for:

- Mapping the supply and demand of natural capital stocks and ecosystem service flows in dryland regions;
- Qualitative assessment of the contribution of these services to human well-being;
- Quantitative and monetary assessment of the contribution of these services to human well-being, to measure the true impacts of further biodiversity losses or returns on investment in conservation.

### ***Recognizing the contributions of natural capital: value and valuation***

Since the 1960s, environmental and ecological economists have been developing and improving methods for recognizing and capturing the contribution of natural capital to economic production and human well-being. These techniques assess the connections between natural capital and economic systems in qualitative and quantitative terms. Where feasible and appropriate, they attribute monetary values to the public or *non-market* properties of nature. These values are aggregated with existing market prices for natural resources to give a fuller picture of the benefits derived from natural capital.

In this context, *value* is defined as the contribution of an action or object to user-specified goals, objectives or conditions (Box 5 describes various definitions of value in more detail). It is worth noting here that just because a good or a service has a value does not necessarily mean it has a price (hence the "economically invisibility" of many ecosystem goods/services).

*Valuation* is the process of expressing a value for a particular good or service in a certain context (e.g. of decision-making), usually in terms of something that can be counted. In economics, such quantification is often, but not always, expressed in monetary terms,<sup>29</sup> while other disciplines (sociology, ecology, etc.) may suggest their own methods and measures.<sup>30</sup>

Valuing natural resources in economic terms increases the economic visibility of these resources. This can then help comparisons be made with alternatives that are usually valued in financial terms (e.g. when choosing between conservation and development plans).

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26 With no dollar figure attached, outcomes from conserving natural capital are rarely captured in markets, and are more often considered *positive externalities*. Similarly, the cost of negative externalities from pollution or land conversion degrading biodiversity are unpriced and/or uncompensated.

27 (e.g., since many of its benefits have been external to markets and prices)

28 Baumol and Oates, 1988.

29 Economic valuation does not mean that only monetary sacrifices, or only services that generate monetary benefits, are taken into consideration. What matters is that individuals are willing to make trade-offs, thus revealing their willingness to pay. Depending on cultural circumstances, estimating non-monetary sacrifices may be more appropriate. If the relevant sample group is for instance subsistence farmers, these trade-offs could also be measured by the labour time individuals are willing to provide in order to achieve some environmentally-friendly outcome.

30 Millennium Ecosystem Assessment, 2005a.

**Box 5: Definitions of “value”**

The Millennium Ecosystem Assessment (2003) defined value as “The contribution of an action or object to user-specified goals, objectives or conditions” (after Farber *et al.*, 2002). According to the Oxford English Dictionary, the term “value” is used in three main ways:

1. Exchange value: the price of a good or service in the market (=market price);
2. Utility: the use value of a good or service, which can be very different from the market price (e.g. the market price of water is very low, but its use value very high; the reverse is the case, for example, for diamonds or other luxury goods);
3. Importance: The appreciation or emotional value that we attach to a given good or service (e.g. the emotional or spiritual experience some people have when viewing wildlife or natural scenery or our ethical considerations regarding the existence value of wildlife).

These three definitions of value roughly coincide with the interpretation of the term value by the three main scientific disciplines involved in ecosystem valuation:

- a. Economics, which is mainly concerned with measuring the exchange value or price to maintain a system or its attributes (Bingham *et al.*, 1995);
- b. Ecology, which measures the role (importance) or attributes or functions of a system to maintain ecosystem resilience and health (Bingham *et al.*, 1995);
- c. Sociology, which tries to find measures for moral assessments (Barry & Oelschlaeger 1996).

Source: R. de Groot *et al.*, 2006, Valuing wetlands: Guidance for valuing the benefits derived from wetland ecosystem services, Ramsar Technical Report No. 3/CBD Technical Series No. 27 (Gland: Ramsar Convention Secretariat and Montreal: Secretariat of the Convention on Biological Diversity).

Valuation does not normally entail measurement of the economic value of biodiversity *as such*. Instead, valuation typically focuses on the economic values of the ecosystem services generated by biodiversity resources and/or functions.<sup>31</sup> The value of ecosystems or species, for instance, derives from the value of the goods and services they supply (discussed further in section 3.3).

Valuation can be used in many ways:

- To assess the total contribution that ecosystems make to human well-being;
- To understand the incentives that individual decision makers face in managing ecosystems in different ways; and
- To evaluate the consequences of alternative courses of action.

The Millennium Ecosystem Assessment uses valuation primarily in the latter sense: as a tool that enhances the ability of decision makers to evaluate trade-offs between alternative ecosystem management regimes and courses of social action that alter the use of ecosystems and the multiple services they provide. This usually requires assessing the change in the mix (of the value) of services provided by an ecosystem resulting from a given change in its management.<sup>32</sup>

31 CBD Secretariat, 2007, p. 8.

32 Millennium Ecosystem Assessment, 2003. *MA Conceptual Framework* [online] Available at: <<http://www.maweb.org/documents/document.765.aspx.pdf>> [Accessed 19 November 2010], p. 34.

### **Box 6: TEEB tiered approach to natural capital valuation**

**Recognizing value** means that society clearly acknowledges and understands the range of benefits, goods and services provided by ecosystems.

**Demonstrating value** means to support decision-making in economic terms, and to consider the full costs and benefits of a proposed use of an ecosystem.

**Capturing value** involves the introduction of mechanisms that incorporate values of ecosystems into decision-making, through incentives and price signals. This can include payments for ecosystem services, reforming environmentally harmful subsidies, introducing tax breaks for conservation, or creating new markets for sustainably produced goods.

The Economics of Ecosystems and Biodiversity (TEEB) sets out the case for natural capital valuation and frames approaches to economic valuation.<sup>33</sup> It follows a tiered approach towards ecosystem valuation by *recognizing*, *demonstrating*, and *capturing* value (see Box 6). This approach helps to make nature more economically visible, thereby influencing key actors to change their decisions and behaviours.

### **Valuation frameworks: Total economic value (TEV)**

Central to natural capital valuation is the concept of total economic value (TEV). This is a framework that can be used to identify a wide range of outcomes from the policy choices ordaining capital allocations. TEEB identifies two approaches to valuing these outcomes: *biophysical* methods and *output value* methods, which are more commonly used in economics.<sup>34</sup>

### **Box 7: The four dimensions of value as measured by economists**

#### **Direct use value:**

i) **Consumptive direct use value** - the value that people derive from actual consumption of goods extracted from ecosystems, e.g. water, fish, wood directly.

ii) **Non-consumptive direct use value** – the value that people derive from interaction with natural systems through recreation or spiritual/cultural gateways, or the educational and scientific knowledge of ecosystems.

**Indirect use value:** The benefits people derive indirectly from ecological functioning of ecosystems including water regulation and purification, soil formation and nutrient cycling, carbon sequestration. Ecological functions are also *positive externalities* as they are the product of natural systems which are not or cannot be privately owned and for which we do not pay the full cost of production/value of provision.

**Option value:** The value of retaining the possibility of using resources in the future, even if the benefits are unknown.

**Non-use value:** The value of knowing that an ecosystem or species continues to exist without ever interacting with it (existence value); the value of knowing that while you will not benefit directly from an ecosystem, others will (altruistic value); the value of knowing that ecosystems will benefit future generations (bequest value).

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33 TEEB, 2010a.

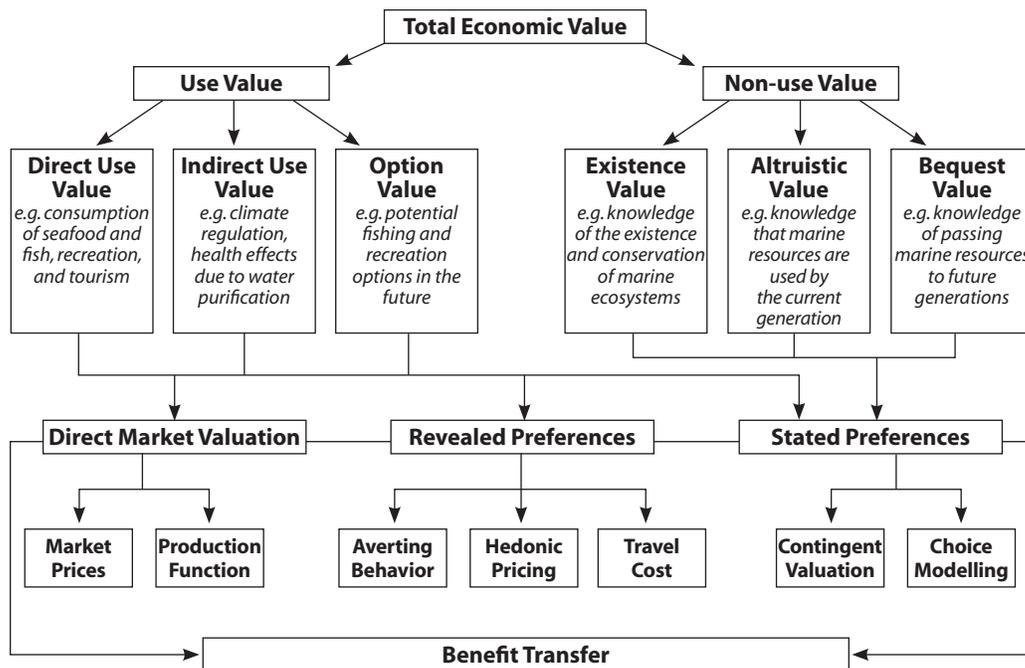
34 See Millennium Ecosystem Assessment (2005) and the Sub-Global Assessment Network (<http://www.ecosystemassessments.net/>) for more information on biodiversity and ecosystem assessment tools.

In the TEV framework, value has four primary dimensions, which, in line with the approach usually taken by economics, are based on possible assignments of value: direct use value, indirect use value, non-use value (where a large portion of biodiversity is hidden), and option value (see Box 7). (Section 3 below provides more detail on the TEV approach.) The four types of value can include both market and non-market (unpriced) components. See also Box 8 for the OSLO six-step assessment model, which utilizes the TEEB approach and its related valuation methodologies (e.g. TEV) in a more land-use-specific way. Figure 2 shows the TEEB TEV framework in graphical form and indicates some methods used for valuation.

**Box 8: Overview of OSLO's six-step assessment model<sup>1</sup>**

<b>Step</b>	<b>Description</b>	<b>Relevant methodologies</b>
<b>1</b>	Inception	Consultations, review of existing reports and papers
<b>2</b>	Land cover assessment	Existing land-use cover developed using GIS in 2002
<b>3</b>	Ecosystem services assessment	Typology as used by the Millennium Ecosystem Assessment (MA) Total economic value Use of existing standards Total carbon estimation and costing
<b>4</b>	Livelihoods and economic development analysis	Participatory rural assessment (PRA) through discussion with key informants and focus group in study villages
<b>5</b>	Land degradation patterns	Total economic value
<b>6</b>	Sustainable land management options	Total economic value

<sup>1</sup> OSLO, Offering Sustainable Land-use Options consortium.

**Figure 2: TEEB TEV framework**

Source: Adapted from TEEB.<sup>35</sup>

### “Monetization” and its uses

There is the risk that by putting monetary figures on elements of nature (“monetization”), some biodiversity values, such as cultural and spiritual values or the intrinsic value of biodiversity, are lost behind numbers that by nature do not capture these values well. However, debates around monetization have at times overshadowed the importance of identifying the TEV of environmental intangibles to inform allocation or investment decisions, which is threefold:

- Valuation **demonstrates how biodiversity loss is a threat for businesses and livelihoods**. Market values do exist for natural capital, but without the perspective of TEV, market values are narrowly interpreted as having only extractive value (i.e. direct use value) and their indirect economic contributions (i.e. non-traded benefits) are overlooked.
- **Valuation is useful as a source of feedback on society’s preferences**, not only for the monetary figures it generates. Valuation results are based on preference orderings that either explicitly or implicitly reflect society’s values and priorities; these do not need to be monetized to be useful.
- A growing body of research shows that **valuation contributes to balanced decision-making**. Since the allocation decisions that natural capital management are concerned with are often made in the context of national development and budget planning, monetary returns will remain a crucial measurement governing public policymaking.

It is also important to recognize that assigning a monetary value to (some elements) of nature is not the same as assigning a price and organizing market-based transactions of such elements (“commodification”). While the application of market-based instruments – for instance, habitat banking approaches<sup>36</sup> or individual transferable quotas (ITQs) in fisheries management – can be one possible policy response to valuation exercises, other policy

<sup>35</sup> NB: option value is sometimes considered separately from use value and non-use value.

<sup>36</sup> See, for instance, <http://britishecologicalsociety.org/blog/blog/2010/03/09/growing-interest-in-habitat-banking/>.

responses – for instance establishment or enlargement of protected areas – are also possible, and may sometimes be more appropriate. In this sense, “monetization” and “commodification” are two different themes.

### ***How valuation can help in the drylands context***

Rapid economic development is anticipated to increase the rate of biodiversity loss in drylands, as in other ecosystems. Degradation of drylands biodiversity is strongly driven by economic considerations, as well as by the disenfranchisement of indigenous or local populations in decision-making related to land-use allocation.<sup>37</sup> Valuation of the goods and services (public and private) delivered by dryland biodiversity is necessary if we are to understand what is lost through inappropriate development choices, e.g. increased urbanization pressures in water-scarce regions and divestment in pastoral economy in favour of water-intensive agriculture.

Valuation will also help us understand what can be gained from pursuing development pathways that are more sensitive to the need to maintain the natural capital of drylands. Similarly, valuation enhances our understanding of opportunity costs related to biodiversity conservation (for instance, what is lost by choosing to conserve our natural capital through protected areas or hunting bans). In cases where land development makes sense, valuation can help us understand how much needs to be conserved without undermining the fundamental flow of services benefiting local and other populations.<sup>38</sup>

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37 Although approximately 9 percent of drylands receive formal protection, protected areas are not representative of all dryland subtypes. Davies *et al.* (2012) suggest this is because areas with the lowest economic value were traditionally the ones designated as protected areas.

Norton-Griffiths and Said, 2009, assert that conversion of Kenya’s rangelands from an extensive pastoral production system to a more intensive agricultural and agropastoral production system, with the attendant elimination of wildlife, is explained by differential net returns to land owners of agricultural, livestock and wildlife production along the rainfall gradient. Similarly, Polasky, *et al.*, 2011, discuss impacts of land use change on ecosystem services in Minnesota, U.S., and demonstrate how returns to landowners are highest in a scenario with large-scale agricultural expansion because losses in habitat quality, stored carbon and negative impacts on water quality are not measured and internalized.

38 See Atkinson *et al.*, 2012.

## 2. THE VALUE OF DRYLANDS BIODIVERSITY AND ECOSYSTEM SERVICES: CURRENT STATE OF ECONOMIC INFORMATION

### 2.1. ECONOMIC VALUE OF DRYLANDS BIODIVERSITY: OVERVIEW

The overwhelming consensus in the literature reviewed is that biodiversity conservation is a worthwhile endeavour in drylands regions. This is not only for the sake of preserving biodiversity in and of itself – though some studies cite the fact that drylands biodiversity conservation helps meet targets under international agreements – but also for the returns that biodiversity brings to livelihoods, poverty reduction, ecological productivity, and ecosystem maintenance and resilience.

Studies place value on the role that biodiversity plays in creating or contributing to direct use, indirect use, and option values with provisioning services, regulating services and cultural services. Examples of some ecosystem services linked to drylands biodiversity are shown in Box 9.

#### **Box 9:** Examples of ecosystem services linked to drylands biodiversity

##### **1) Provisioning services:**

- a. Rain-fed and irrigated agriculture and agroforestry for commercial and subsistence purposes;
- b. Timber, non-timber and non-wood products harvested for commercial and subsistence purposes;
- c. Pastoral activities (i.e. production of livestock and livestock products) on rangeland and grasslands for commercial and subsistence purposes;
- d. Water provisioning derived from maintaining and improving watersheds, river systems, wetlands and aquifers;
- e. Animal and plant genetic resources for commercial and non-commercial uses (e.g. biotechnology industry, taxonomy).

##### **2) Regulating services:**

- a. Carbon sequestration in grasslands, rangelands and dryland forests;
- b. Water regulation and flood management;
- c. Soil maintenance, erosion regulation and nutrient cycling by migratory herds and wildlife;
- d. Other: pollination services by insects and migratory birds.

##### **3) Cultural services:**

- a. Cultural identity and diversity;
- b. Cultural landscapes and heritage values;
- c. Indigenous knowledge systems;
- d. Protected areas and national reserves providing tourism opportunities;
- e. Spiritual, aesthetic and inspirational values.

##### **4) Supporting services:**

- a. Contribution to soil formation;
- b. Photosynthesis;
- c. Nutrient and water recycling.

Value chains for products traded in local to international economies – like wheat, sunflower products, livestock and meat, honey, desert truffles, medicinal and cosmetic products – contribute directly to supply chains of the agricultural/agroforestry, livestock, pharmaceutical and cosmetics sectors. Watersheds in drylands provide water inputs for agriculture, pastoral activities (which can also include dryland agricultural activities and collection of non-timber forest products), industrial activities, and domestic consumption. What is more, dryland biodiversity – variety in landscapes, habitats and species – and human cultures in drylands are central to the burgeoning tourism sectors in many countries.

Finally, dryland ecosystem functioning also supports carbon sequestration, water regulation, nutrient cycling, and other ecological services that support local populations and downstream urban beneficiaries and contribute to global climate regulation.

## 2.2. CONSIDERATIONS AND CHALLENGES FOR VALUATION IN DRYLAND REGIONS

Specific considerations relevant to the valuation of natural capital in dryland regions include the following:

- Given poverty levels in many of these zones, populations may be highly dependent on natural capital for subsistence hunting or gathering to supplement incomes or nutritional requirements;
- Drylands livelihoods are intimately linked with agricultural, pastoral and forest productive systems and wildlife tourism;
- Water is limited and in many cases poorly managed in dryland contexts (specifically with the shift from rain-fed to irrigated systems). Therefore rainfall indices, groundwater abstraction and watershed maintenance are key considerations in understanding land-use choices, ecosystem functioning and human well-being in these regions;
- Biodiversity value in drylands is primarily linked to uniqueness of flora, fauna and habitats found in these regions. Drylands host many unique habitats and species for which restoration is not an option, but not much baseline information exists to show what this irreplaceability may mean in reality; or
- The issue of land ownership and its impact on biodiversity and ecosystem service valuation is a consideration.

Biodiversity valuation in dryland and sub-humid zones faces various challenges:

- **Complexity.** The diversity of drylands ecosystems and species, and the lack of scientific information quantifying the relationship between biodiversity and ecosystem services, or other economic system interactions, makes it challenging to capture biodiversity conservation benefits with reasonable clarity.
- **Data limitations.** Data on pastoralism, yields on cultivated land, market prices, and almost any aspect of valuation work are difficult to find. Official statistics can be haphazard and potentially biased. For many services, data about global conditions and trends are not readily available, and only generic information about processes governing the condition of these services is provided. Baseline information on biodiversity and ecosystem services is poor.
- **Differences in classifications, categorizations and valuation frameworks.** Following models and sourcing information from other studies may be challenging. It was observed that:
  - 1) No studies clearly define the climate of their study area in the same terms as UNCCD, for instance (e.g. arid, semi-arid, dry sub-humid);
  - 2) Ecosystems, biomes, land covers/uses can be defined differently;
  - 3) Classification of ecosystem services varies, depending on the ecosystem services frameworks used or how these have been adapted to particular studies;

- 4) TEV frameworks are not used in all studies;
  - 5) Use, non-use and option values are defined or interpreted differently in many studies;
  - 6) Categorization of benefits differs from study to study, even when the subject is the same.
- **Unknown thresholds.** The marginal value of drylands biodiversity and its ecosystem goods and services proved difficult to assess since the significant threshold points, after which goods and services are diminished to a point where they are lost, are largely unknown. The precautionary principle is recommended for such cases.
  - **Bundling of services.** The question of whether to value ecosystem services separately and then aggregate them, or value them together as jointly produced, is a challenge common to many ecosystem service valuation studies.
  - **Mobility of some dryland peoples.** The benefits of biodiversity to pastoralist activities are dispersed, as are the benefits of migratory pastoralism to conditioning of dryland ecosystems. Where benefits move they can be even more difficult to measure.
  - **Social and political upheaval.** Many dryland ecosystems are located in particularly unstable human environments which can change the way people work or live on the land. Such instability can sometimes lead to conflict which results in further dispersal and relocation of drylands peoples.

### 2.3. COVERAGE OF DRYLANDS BIODIVERSITY VALUATION IN THE LITERATURE: GAP ANALYSIS:

The literature review revealed a number of gaps in the coverage of biodiversity valuation in drylands contexts. It also revealed a few technical considerations that could improve the quality of studies.

There are **large regional disparities** in terms of availability of economic studies in this area, despite the fact that drylands are found throughout the world. A large share of information is focused on sub-Saharan Africa, with relatively little available on other regions. This may reflect a strong focus on direct use values in the literature, particularly related to pastoralist activities. The emphasis is understandable, given the importance of drylands in sub-Saharan Africa, but it represents a gap in information on environmental and land-use management in dryland systems found elsewhere.<sup>39</sup>

**The different value types are treated variably** in existing drylands biodiversity valuation analyses. Use values are more significant than non-use. Option values are highlighted qualitatively but not quantified in the literature. Moreover, in areas with low population densities, low direct use values are attributed because the number of people to hold value is low. Without a better understanding of the ecological functions these ecosystems perform regionally and globally, indirect use values appear insignificant. Similarly, non-use values, such as the knowledge that a threatened species will endure for future generations, are either not valued for all regions or are focused largely on iconic species (which may or may not capture the value of underlying biodiversity). This implies a need for more well-rounded analysis of value types in drylands biodiversity valuation studies, or at least an acknowledgement of these gaps as limitations.

Not all **drylands ecosystems and services** are well represented in the economic literature. Within drylands, wetlands and inland waterways are obvious gaps, as are deserts (hot and cold) and steppe landscapes. Also, valuation related to genes and species is less significant in the literature, apart from the (non-consumptive) demand to view wildlife. There is a strong cultural dimension to valuation of drylands biodiversity valuation but it does not feature greatly in the valuation literature, except for ad hoc qualitative mentions. This indicates the need for further work in participatory valuation, and in other forms of valuation without monetization. Finally, environment-health linkages are generally not well made.

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39 See: <http://www.greenfacts.org/en/desertification/1-2/3-impacts-desertification.htm>.

### ***Making the economic contributions of biodiversity more visible***

The economic contribution of biodiversity may need to be further “unpacked”. Knowledge of what is provided by ecosystems is crucial for performing valuation studies, but it is also important to understand the way in which intermediate tiers of production contribute to ecosystem service output. This is important for **making the economic contribution of biodiversity more visible** in decision-making processes, particularly for decisions concerning land-use allocations or concessions or implementation of agricultural, pastoral or wildlife protection policies.

Similarly, where **information on market structures** is missing, it is challenging to understand where costs and benefits are accrued up and down value chains. To permit better estimation of the value of drylands biodiversity, information is required on value chains for dryland products that are supported by natural capital or tracing supply chains of corporate “demanders” of dryland biodiversity. This is relevant for both legal and illegal trade of dryland products, whether agricultural, pastoral, forest or wildlife-related.

### ***Evaluating benefits over time and assessing relative benefits***

Economists stress the need to evaluate benefits (and costs) of different choices over time. Yet the question of long time frames and **discounting** – a stage in cost-benefit analysis that uses a discount rate, typically between 0 and 8%, to calculate the net present value of returns on an investment accrued over time (discussed further in section 4) – does not feature strongly in the literature on drylands biodiversity valuation. Many studies are static valuations, rather than comparisons between the outcomes of different land uses or productivity (i.e. quality or degradation).

A key assumption in economic theory underpinning investment in natural capital is that increased ecosystem protection or enhancement will improve the flow of benefits over time. Conversely, it is assumed that degradation, or a change in land use, will disrupt ecosystem service delivery. This means that economic analyses have a dynamic element that is not well captured when valuing services for current periods alone.<sup>40</sup>

Equally, TEV studies have little meaning when they stand alone. For decision-making regarding enhancement, maintenance or use of natural capital resources, information is required for the TEV of the **relative benefits** of different states (quantity or quality) of these resources.

### ***Relevance to policy and design of incentives***

Many studies currently available to inform drylands biodiversity conservation do not discuss the **policy relevancy and implications** of their results for incentives design (including designation of land rights or concessions), financing schemes, payments for ecosystem services (PES), or other market mechanisms to any significant extent.

In wildlife conservation, for example, the existing information reflects people’s preferences for protecting drylands wildlife internationally (reflected by both use and non-use values), but this has not translated into policy or incentive measures or markets large enough (e.g. safari tourism) to compensate drylands people living with the costs of wildlife “production”, such as crop losses. However, there are some cases when valuation studies, and particularly those that have used the travel cost method (international tourism), have led to increased entry fees for national parks

### ***Distributional questions***

The literature also suggests a gap in understanding of the distribution of ecosystem functions and ecosystem services provided by drylands. This includes questions such as who is benefitting from these functions and services, and where? And conversely, who is maintaining or protecting them?

40 Atkinson, Bateman and Mourato, 2012.

## 2.4. CONCLUDING REMARKS

Economic analysis of biodiversity is complex. Reaching a specific definition of what biodiversity “is”, how it can be measured, how it supports ecosystem services delivered to humans and other species and how these services intersect with economic systems – at least sufficiently to perform robust analyses – is a challenging task. Helm and Hepburn (2012) assert that such obstacles explain in part why economic analysis of biodiversity has received nowhere near enough attention in the economics discipline.

Dryland biodiversity valuation presents its own set of challenges. Biodiversity valuation is frequently targeted at valuing habitats, landscapes or land uses, as opposed to individual species.<sup>41</sup> This is partly a function of the fact that biodiversity conservation is often pursued with a focus on nature reserves and protected areas. It is also a function of the complexity of valuing other dimensions of biodiversity in detail – e.g. valuing the economic contributions of predator species outside of nature reserve tourism revenue. However, within drylands, the variety of habitats or land covers – not to mention the variety of unique and endemic flora and fauna species – is considerable. Furthermore, the interconnectedness of dryland ecosystems means that if one part is damaged or removed, it is likely to have a negative impact on the system as a whole. This is particularly the case for riverine areas, for example; their removal or modification (for other land uses) can have severe negative repercussions on the use of the rest of the rangeland/dryland.

Despite these challenges, there is increasing momentum towards developing a better understanding of how people benefit from nature in drylands, under the climatic limitations, rapid population growth and urbanization that characterize these regions.

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41 The issue of part-whole bias arises when the sum of values of individual species is greater than the value for all species as a whole. As there is a risk to overestimate the true value of all species when adding up individual species values, it is often easier to value the habitats.

### 3. FILLING KNOWLEDGE GAPS: CONDUCTING VALUATION STUDIES

This section presents a step-by-step process for completing good quality studies of biodiversity values, including from dryland regions, to accomplish the following:

- Qualify the links between biodiversity, ecosystem service production and human well-being;
- Quantify, or scientifically measure, these interactions; and
- When appropriate, monetize the costs and benefits of changes in biodiversity quality.

Execution of this type of stepwise approach, and determining appropriate use of valuation results, would be instrumental in informing larger governmental processes of integrated planning for drylands.

The process described below includes several steps:

- Initial study design: Determining whether economic valuation is the right tool (Step 1);
- Framing the analysis: describing issues and objectives; involving stakeholders (Step 2);
- Developing a TEV (total economic value) framework (Step 3);
- Scenario-building: Describing the baseline for biodiversity in a study zone, and assessing drivers of change (Step 4);
- Identifying key values and beneficiaries under the different scenarios (Step 5);
- Mapping data requirements under the TEV framework (Step 6);
- Valuation (market and non-market methods) (Step 7);
- Aggregating results across types of values and services (Step 8).

#### 3.1. STEP 1. INITIAL STUDY DESIGN: DECIDING WHETHER ECONOMIC VALUATION IS THE RIGHT TOOL FOR THE PROBLEM

Economic valuation<sup>42</sup> is just one approach to navigating the relationship between humans, nature and biodiversity in making decisions about how natural and other resources are managed. Ascertaining economic values through valuation can have both advantages and disadvantages.

One of the key advantages of valuation is that results can translate to a broad range of very different values in one simple metric/indicator for decision makers (quantitative value) and this can facilitate comparisons. At the same time, economic valuation approaches, and particularly those followed by TEEB and the OSLO consortium, do not necessarily focus on the economic returns from what is being valued; they can provide more of a holistic assessment whereby social and environmental factors are also taken into consideration.

Economic valuation can contribute to:

- Answering policy questions. As a general rule, valuation studies should have a clear focus on comparison of outcomes from specific policy, land-use changes or improvements/degradation in biodiversity and ecosystem service delivery;

<sup>42</sup> It should be noted that not all values can be expressed in quantitative terms, hence the need to embed complementary qualitative indicators in the economic assessment.

- Recognizing interlinkages between biodiversity/ecosystem services and the economy, including livelihood, food security, economic sectors, or markets to which dryland products contribute (e.g. hides, safari tours);
- Improved understanding of the economic drivers of land use change, including by showing how market failures occur due to unaccounted negative and positive externalities that result in intensification of unsustainable land uses and reduced diversity of land covers;
- Estimating the value of some non-market ecosystem services, including subsistence consumption of dryland agricultural, pastoral or forest products, regulating services (e.g. water and nutrient cycling), and non-use values;
- Packaging drylands natural capital in the language of key policymakers (e.g. finance, trade and industry ministers), so that it can be better integrated into decision-making on biodiversity conservation, economic development, and poverty reduction;
- Changing consumption (and production) behaviour.

Generally, it is not recommended that economic valuation be used:

- For “pricing the priceless”. While it may be technically possible to calculate a monetary number for the value that a place of great spiritual or cultural importance holds for people, the question is whether such a number would really contribute to a better understanding of how that place is valued, or whether it would rather confuse the discussion;
- As the sole basis for decision-making. Economic analysis supplies a much needed understanding of how economic systems and human well-being depend on having “enough” biodiversity, and can explain why biodiversity stocks are overexploited and receive little investment; but it adds just one additional piece of information in the whole information set – socioeconomic and cultural – that policymakers must take into consideration.

Regarding limitations, as noted earlier, the monetization of nature can lead to the risk of biodiversity values, especially those related to cultural or spiritual values, being lost behind “numbers” whereby such values are not captured. Moreover, attempts to assess the value of biodiversity conservation, as well as what and how much to conserve, are hampered by inadequate scientific information. The services that biodiversity supports and delivers are often poorly understood, and it is nearly impossible to define critical thresholds (precautionary principle), substitutability or implications of irreversibility with regards to biodiversity loss with current scientific knowledge.<sup>43</sup>

Furthermore, the technical challenges of accurate or plausible valuation can be considerable, as is the expense of conducting valuation studies.<sup>44</sup> Finally, poor communication among practitioners, policymakers and other stakeholders about what some attributed values mean in reality can undermine actual decision-making. When the misconception that artificial dollar values mean actual financial inflows is corrected, non-market valuation results can seem pointless to some policymakers. For some decision makers, focusing attention on the value of non-market ecosystem services may be sufficient. For others, theoretical valuations are unconvincing unless accompanied by evidence of how biodiversity and ecosystem services are tangibly linked to important economic sectors, productivity and job creation, for example.

Bearing in mind all these advantages and disadvantages, the first question is: will a valuation study contribute positively or negatively or not at all to the particular problem at hand?

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<sup>43</sup> See Neumayer, 2004, and Verbruggen, 2013, for more discussion.

<sup>44</sup> See Heinzerling and Ackerman, 2002 for an accessible overview of the limitations of cost-benefit analysis; on non-market valuation through contingent valuation, see Diamond and Hausman, 1994, and Carson *et al.*, 2001.

### 3.2. STEP 2. FRAMING THE ANALYSIS

An important step for tackling the complexity of economic analysis of biodiversity and ecosystem services in valuation studies is to frame the analysis clearly and pragmatically. This involves describing the issue, identifying the objective of the valuation, and involving stakeholders throughout the process.

#### 3.2.1. Describing the issue

The first step is to describe the issue of concern in a way that illustrates why a valuation analysis is a worthwhile endeavour. A strong narrative will answer the following questions:

- What is biodiversity in dry and sub-humid lands? Why is it important and at what scale does it have an impact?
- What is the distributional analysis? (i.e. who are the stewards, the users and the beneficiaries of dryland biodiversity?)
- What is the problem? What are the drivers of this problem?
- What are the biodiversity quality and quantity outcomes of changes in the status quo (e.g. proposed changes in land-use policy) and the broad implications of these changes, in environmental, social and economic terms?
- What are the main economic dimensions of the problem?
  - How is that particular aspect of biodiversity linked to livelihoods and subsistence food production? Is there a strong poverty reduction or rural economic development connection?
  - What economic sectors and supply chains – particularly those highlighted as of key strategic importance in national development plans – are impacted?
  - Are there human health, unique cultural or historic dimensions or other socioeconomic considerations?
- What are the likely positive outcomes from reducing or preventing the problem?

#### 3.2.2. Identifying the objective of the valuation

While the broad aim might be to ascertain the value of “biodiversity”, the scale of such an exercise would be too large to produce meaningful results. Furthermore, there is likely a large scope for error, reflecting the numerous variables that may be encountered in such an exercise.

Many studies value group or individual provisioning, regulating and/or cultural services delivered by different land covers and through economic activities linked to specific land covers (e.g. dryland agriculture, dryland forests, or protected area tourism). Others focus on a particular species of wildlife (e.g. rhinoceros, lion, flamingo), or attempt to evaluate the economic impacts of land degradation in dryland areas.

Whatever the scope of a valuation study, it should be

- **Relevant** – that is, responding to an identified policy need;
- **Clear**;
- **Practical**; and
- **Determined through consultation** with project team members and all critical stakeholders who will have significant influence on the acceptance of analysis results from the outset.

Different scopes in the literature on dry and sub-humid biodiversity valuation include:

- **Changes in provisioning services** resulting from improvement, rehabilitation or restoration of biodiversity in dryland zones through sustainable agriculture techniques (including agroforestry) or community-based management of forests;

- **Changes in regulating services** resulting from improvement, rehabilitation or restoration of biodiversity in dryland zones, such as improved management of upland forests in watersheds, and nutrient cycling services from pastoral herds.
- **Comparisons of ecosystem services and economic benefits under different land uses**, e.g. conversion of pastoral land to agriculture, or building hydroelectric power infrastructure in dryland water systems;
- **Costs of inaction** resulting from continuing status quo rates of biodiversity and ecosystem service loss, and from continued land degradation, including reduced agricultural yields;
- **Evaluation of actual benefits of policy interventions**, e.g. specific conservation programmes, sustainable land management training for farmers and pastoralists and raising public awareness more generally, encouraging facilitation between different stakeholders.

### 3.2.3. The importance of stakeholder engagement, participation and consultation

Engaging with stakeholders, from local (those residing in dry and sub-humid lands themselves) to global users and consumers, is essential throughout the valuation process (see Box 10 for a successful example in Mongolia). It includes building solid and lasting partnerships throughout the project duration. Stakeholder engagement and consultation are particularly crucial at the very early phases of a valuation project, especially with those who may be more directly affected at the local and national levels.

Consulting with local,<sup>45</sup> national and other stakeholders will help to:

- Understand more about the issues which may be at stake within certain stakeholder groups (e.g. local communities, municipalities, ministries, NGOs) that hold traditional and local knowledge that is essential to framing valuation studies;
- Cultivate local and national capacity for execution of valuation studies (e.g. through strong capacity-building and consultation processes);
- Identify good governance structures and stakeholder dialogues that are fully participatory;
- Agree on ways forward among and between stakeholders;
- Gain community-wide buy-in and increase the longevity and success of the projects.

Stakeholders may include:

- Locally affected individuals and communities dependent on dryland biodiversity and ecosystem services impacting livelihoods and food security, or places of cultural or religious significance. Dryland farming communities and pastoral communities are two particularly important examples, as are local politicians and religious leaders;
- Downstream urban communities that benefit directly and indirectly from the production of dryland biodiversity and ecosystem services, particularly city/municipal authorities charged with maintaining public services such as waste management or water provision;
- Local authority, environment agency and national ministry representatives with mandates on local public service provision, i.e. water provision, environmental management, agriculture, industry and trade, development.
- Civil society organizations – local, national and international – with an interest in social, environmental and livelihood issues;

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45 Visits to the field are particularly important for a correct assessment of the dynamic of the area.

- Special interest groups, including representatives of industry and other associations or entities with activities in dry and sub-humid lands (e.g. the World Agroforestry Centre (ICRAF));
- Local entrepreneurs and business people, or multinationals whose trade or supply chains may depend upon dryland biodiversity products;
- National, regional and local government planners;
- The academic and research community – particularly ecologists, economists, policy analysts etc. with an understanding of linkages between dryland biodiversity and ecosystem services, how their quality may be changing with land-use change and other drivers of biodiversity loss in these regions, and what impacts this might have on local and national economies;
- Intergovernmental organizations and donors (e.g. UNDP national offices, UNEP regional offices, UNESCO World Heritage Programme, the International Labour Organization).

Institutional-level stakeholder analysis and mapping – and listening to the expertise and experience held within a wide range of organizations – is important for establishing buy-in for valuation projects, achieving a good project design, and ensuring that the analysis results are accepted and utilized.

Local stakeholder analysis, mapping and effective engagement can help to improve our understanding of how projected changes within dryland environments are likely to affect the livelihoods of the people who live in these regions (see Box 11 for an example). They will also crucially inform how the valuation exercise should proceed.

Continued stakeholder relationships are important for cultivating good governance, validating study results and ensuring equity in decisions concerning policy objectives and instruments. A solid stakeholder participatory process may lay the groundwork for community-based or collaborative management projects long after the valuation project is completed. Toolbox 1 outlines some key stakeholder engagement guidance and examples.

#### **Box 10:** Case study synopsis: Measuring the impacts of community-based grasslands management in Mongolia's Gobi

**Background:** The study assessed a donor-funded grassland management project designed to create both conservation and livelihood benefits in the rangelands of Mongolia's Gobi desert.

**Methods:** The project ran from 1995 to 2006, and the researchers used remote sensing Normalized Differential Vegetation Index data from 1982 to 2009 to compare project grazing sites to matched control sites before and after the project's implementation. To better understand the benefits of improved grasslands to local people, they conducted 280 household interviews, 8 focus group discussions, and 31 key informant interviews across 6 districts.

**Results:** The productivity of project grazing sites was on average within 1% of control sites for the 20 years before the project but generated 11% more biomass on average than the control areas from 2000 to 2009. There was a 12% greater median annual income as well as a range of other socioeconomic benefits for project households compared to control households in the same area.

**Conclusions:** Overall, the project generated measurable benefits to both nature and people. The key factors underlying project achievements that may be replicable by other conservation projects include the community-driven approach of the project, knowledge exchanges within and between communities inside and outside the country, a project-supported local community organizer in each district, and strong community leadership.

Source: Text taken from C. Leisher, S. Hess, T. Boucher, P. van Beukering and M. Sanjayan, 2012, Measuring the impacts of community-based grasslands management in Mongolia's Gobi, PLoS ONE, 7(2), e30991.

### **Box 11:** Case study synopsis: Indigenous knowledge in Shinyanga, Tanzania

**TEEBcase:** Restoring Woodlands, Sequestering Carbon and Benefiting Livelihoods in Shinyanga, Tanzania

**Problem:** The Shinyanga Region in Central Tanzania, formerly extensively forest with dense woodland and bushland species, came to be called “The Desert of Tanzania” after drought, overgrazing, and political changes reduced forest cover, increased soil erosion, and threatened livelihoods.

**Response:** In 1986, a government initiative, Hifadhi Ardhi Shinyanga (HASHI) was instrumental in reviving the Sukuma people’s traditional practice of conservation, relying on indigenous knowledge to create and restore forests and improve livelihoods in the region. By 2002, between 300,000 and 500,000 hectares of *Ngitili* (a natural resource management system) were restored in the 833 villages of the region, affecting more than 2 million people.

**Ecosystem Services Examined:** The multiplicity of goods provided by trees, like fuel, fruits, building timber, honey, medicines and fodder, and the ecosystem services provided by the forests, like water catchment, erosion reduction and cultural meaning, were recognized as crucial for the livelihoods of the Sukuma people. To protect and restore these goods and services, participatory planning involved women’s groups, youth, village government and individual farmers. Forest restoration included planting trees, fencing, reducing grazing, natural regeneration of trees in the forests and on farmland, and agroforestry.

**Important Insights:** (1) The economic value of a restored *Ngitili* per month is higher than the national average for rural consumption per month; (2) Sukuma agropastoralists also noted that trees and catchment conservation also improve water quality, restored woodlands provide fodder for oxen, and that revenues from the sale of tree products pay for children’s schooling; (3) *Ngitilis* have also made a large contribution to carbon sequestration.

**Policy Uptake:** The HASHI program recognized the importance of the traditional practices of managing forests with enclosures (*Ngitili*) and used the traditional knowledge of the Sukuma people as the basis for the restoration. This increased local people’s ownership over and capacity to manage natural resources and gained support and investment from the Government of Tanzania and the Government of the Kingdom of Norway, in addition to spreading to neighbouring regions in Tanzania.

**Lessons Learned:** As the value of *Ngitilis* has risen, the rich and powerful have tried to consolidate their own rights and benefits at the expense of the less powerful. The poorest have tended to deal with occasional shocks by selling their farmland to wealthier men who convert it to private forest, often for cattle grazing. The balance between land put under private and communal *Ngitilis* has shifted in the direction of the former so the landless are losing access to communal *Ngitili* products and their own land.

The *Ngitili* case is an important example of trends which will become more common as REDD carbon schemes and other kinds of PES schemes come into existence: if resources acquire greater value, there will be greater competition for ownership of them. The response must be improved tenure and legal resources for the poor, or we shall see much injustice and impoverishment as a result of these schemes.

Source: Text taken from E. Barrow and A. Shah, 2011, TEEBcase: Traditional forest restoration in Tanzania [pdf] Available at: <TEEBweb.org> [Accessed 25 October 2012].

**Toolbox 1: Stakeholder engagement: guidance and examples**

**CBD, GEF and UNEP**, 2007, *Ensuring stakeholder engagement in the development, implementation and updating of NBSAPs, Module B-5* [pdf] Available at: <<http://www.cbd.int/doc/training/nbsap/b5-train-stakeholder-nbsap-en.pdf>>.

**EDIT** (European Distributed Institute of Taxonomy), 2007, *Stakeholder report 1: Stakeholder engagement in biodiversity and environmental projects. A comparison of arguments, methodologies and results of stakeholder engagement in ten international projects* [pdf] Available at: <<http://www.e-taxonomy.eu/files/StakeholderReport1.pdf>>.

**CEPA** (Communication, Education, Participation and Public Awareness) Toolkit, *Section 3: How to engage stakeholders and mainstream biodiversity?* [pdf] Available at: <<http://www.cepatoolkit.org/html/resources/40/401D521E-2A0A-47BB-85F6-BBDC158B4B58/Section%203%20final%200904.pdf>>.

**JNCC** (Joint Nature Conservation Committee), *BiodivERSA stakeholder engagement workshop: Organized and hosted by the Joint Nature Conservation Committee (JNCC), Peterborough, UK, 23-24 April 2013* [online] Available at: <<http://jncc.defra.gov.uk/default.aspx?page=6059>>.

**3.3. STEP 3. DEVELOPING A TEV FRAMEWORK FOR BIODIVERSITY IN DRYLANDS**

This guidance proposes using the TEV approach because it allows us to combine market and non-market information to give a holistic picture of the value assigned to aspects of natural capital such as habitat or species diversity. This ultimately allows an estimate of their true worth to be included in resource allocation decisions that decide “how much” biodiversity conservation can be exchanged against other uses of scarce resources.

Welfare economics is the foundation for economic valuation methods. Economists interpret changes in welfare using individual utility functions and considering marginal changes in utility. Utility functions describe the *value* that individuals place on obtaining an additional “unit” of goods or service from the policy in question by what they are willing to give up to get it.

***Including different dimensions of value***

A TEV framework lays out all dimensions of “value” to be considered in estimating the benefits from a resource. As indicated earlier (see Box 7. The four dimensions of value as measured by economists<sup>7</sup> above), “value” has four primary dimensions in total economic value (TEV) frameworks:

- Direct use value;
- Indirect use value;
- Non-use value (bequest, altruistic and existence); and
- Option value.

The four types of value can include both market and non-market (unpriced) components. These can be quantified using market and non-market-based valuation techniques (step 7 below). The TEV is the sum of all benefits obtained from a resource; nonmonetary benefits are monetized so that they can be added to market values:

$$\text{TEV} = \text{Use value (direct and indirect)} + \text{Option value} + \text{Non-use value (bequest + altruistic + existence value)}$$

When designing a TEV framework, not all dimensions of drylands biodiversity have to be incorporated (see Toolbox 2 for some useful references for TEV framework building for different aspects of drylands biodiversity). The degree of relevance of different types of value will change depending on the valuation focus.

### ***Ecosystem service typologies, and linkages to biodiversity***

As noted earlier, dryland biodiversity is part of the stock of natural capital that supports the flow of material and less tangible ecosystem services to both local and nonlocal populations. The value of individual ecosystems or species derives from the value of the goods and services they supply.

A practical and consistent definition and typology of ecosystem services and biodiversity, and an understanding of how these are linked, is essential to identifying and valuing the economic benefits of biodiversity. The work of TEEB and others provides a framework that will contribute to the consistency in definitions and understanding that is much needed in biodiversity valuation. Table 1 applies this framework to ecosystem services relevant to the dry and sub-humid land context.

The majority of studies estimate ecosystem service benefits flowing from different land cover classifications (e.g. grasslands and rangelands), or value provisioning, regulating and cultural service benefits delivered by economic activities like tourism, agriculture or pastoralism linked to specific land covers or species. This is likely because identifying relationships between biodiversity, ecological functioning, and ecosystem services poses significant challenges for practitioners. Table 2 summarizes some of the interactions between dryland biodiversity and the typology of ecosystem services. It is based on information in Safriel *et al.* (2005) and the wide range of research reviewed in our literature analysis.

At the very least, practitioners should aim to highlight the linkages between biodiversity and ecosystem services qualitatively in their studies.

### ***Bundled ecosystem services***

A particular difficulty that receives attention in biodiversity valuation literature is that of “bundled” ecosystem services. Ecosystem services can be identified and valued separately before being aggregated, e.g. dryland forest restoration can be estimated by summing the separate values of several ecosystem services it delivers (carbon sequestration, non-timber forest products, timber, tourism, and livestock production). However, these services could also be valued as jointly produced or “bundled”. For instance, a standing forest provides both biodiversity maintenance and carbon sequestration benefits, and the more diverse the forest the greater the number of multiple ecosystem services produced.<sup>46</sup> The problem lies in the fact that if valued separately, the sum of individual services overestimates the value of the resource.<sup>47</sup> The priority is a feasible study design with the possibility of using reliable existing information and/or the potential to generate theoretically robust estimates for the biodiversity and ecosystem service values most relevant to the study objective.

### ***Examples of possible TEV components under different land covers***

Table 3 gives an overview of various values that could be included in a TEV analysis of dry and sub-humid land biodiversity, organized by land cover and economic activity as well as by ecosystem service category, to assist practitioners in selecting which values to include. This table is based on the review of over 100 studies relevant to drylands ecosystem services and biodiversity valuation. TEEB (2010a) shows how supporting services are captured through valuing the other categories of ecosystem services; the analysis thus focuses on provisioning, regulating and cultural services.

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46 See <http://www.nature.com/ncomms/journal/v4/n1/full/ncomms2328.html>.

47 See Quillérou and Thomas, 2012.

**Table 1:** Ecosystem services framework applied to dry and sub-humid lands<sup>1</sup>

<b>Provisioning Services</b>	<b>Regulating Services</b>	<b>Cultural Services</b>
<b>THE GOODS OR PRODUCTS OBTAINED FROM ECOSYSTEMS</b>	<b>THE BENEFITS OBTAINED FROM AN ECOSYSTEM'S CONTROL OF NATURAL PROCESSES</b>	<b>THE NON-MATERIAL BENEFITS OBTAINED FROM ECOSYSTEMS</b>
Food (e.g. fish, game, fruit, crop yields)	Air quality regulation (e.g. capturing sand, dust)	Aesthetic information
Water (e.g. for drinking, irrigation, cooling)	Climate regulation (incl. carbon sequestration, influence of vegetation on rainfall, etc.)	Opportunities for recreation & tourism (e.g. natural reserves, game parks, World Heritage Sites)
Raw materials (e.g. fibre, timber, fuelwood, fodder, fertilizer)	Moderation of extreme events (e.g. storm protection and flood prevention)	Inspiration for culture, art and design
Genetic resources (e.g. for crop or herd improvements, medicinal purposes)	Regulation of water flows (e.g. natural drainage, irrigation and drought prevention)	Spiritual experience
Medicinal resources (e.g. biochemical products, models & test organisms)	Waste treatment (especially water purification)	Information (e.g. cognitive development, scientific knowledge)
Ornamental resources (e.g. artisan work, decorative plants, pet animals, fashion)	Erosion prevention	
	Salinization prevention	
	Pollination, seed dispersal, biological control (e.g. pest and disease control)	
<b>Supporting Services<sup>2</sup> - SERVICES SUPPORTING THE PROVISION OF OTHER SERVICES</b>		
Soil formation and maintenance		
Photosynthesis		
Nutrient and water cycling		

1 Adapted from the Millennium Ecosystem Assessment, 2005b; and TEEB, 2010a.

2 Supporting services are not usually valued in economics terms as this would often lead to double counting.

**Table 2:** Typology of ecosystem services<sup>1</sup> and their linkages to biodiversity in dry and sub-humid zones

<b>ECOSYSTEM SERVICES FRAMEWORK APPLIED TO DRYLAND AND SUB-HUMID REGIONS: EXAMPLES</b>	<b>ECOSYSTEM SERVICE DELIVERY SUPPORT FROM DRYLANDS BIODIVERSITY AND BIODIVERSITY CONSERVATION MEASURES</b>
<b>Provisioning Services: goods or products obtained from ecosystems</b>	<i>Greater animal and plant diversity means a wider range of goods or products being obtained from ecosystems</i>
Food (e.g. game, meat, milk, crop yields, fish)	Variety needed to meet a diversity of local nutritional needs
Water (e.g. for drinking, irrigation, cooling)	Conservation and rehabilitation of degraded vegetation cover generates and captures surface runoff for deep storage in soil and groundwater reserves; Dryland varieties of plant, crop and other vegetation cover varieties can lower consumptive water demand in agriculture
Raw materials (e.g. fibre, timber, fuelwood, fodder, fertilizer)	Variety needed to meet a diversity of local needs; variety of vegetation cover and animal life supports natural nutrient production
Genetic resources (e.g. for crop/herd improvements, medicinal purposes)	Drought- and disease-resistant crop and livestock varieties
Medicinal resources (e.g. biochemical products, models & test organisms)	Variety needed to meet a diversity of local needs, multinational supply chains
Ornamental resources (e.g. artisan work, decorative plants, pet animals, fashion)	Uniqueness of local product important for artisanal-based industries
<b>Regulating Services: benefits from an ecosystem's control of natural processes</b>	<i>Better quality of biodiversity means more effective ecosystem functioning</i>
Air quality regulation (e.g. capturing sand, dust)	Dust and sandstorm control or mitigation by mixed vegetation types
Climate regulation (incl. carbon sequestration, influence of vegetation on rainfall, etc.)	Biodiversity supports climate regulation through controlling evapotranspiration, albedo, shade, moisture transfer; climate change mitigation and adaptation both impacted upon by species diversity
Moderation of extreme events (e.g. storm protection and flood prevention)	Diversity in vegetation cover supports the moderation of impacts from extreme climatic and other events. Drought impact mitigation is a crucial service in drylands contexts that is supported by diverse plants and animals that meet human and animal nutritional and fluid needs
Regulation of water flows (e.g. natural drainage, irrigation and drought prevention)	Conservation and rehabilitation of degraded vegetation cover adapted to dryland conditions can lower water demands in dryland regions and support maintenance of aquifers
Waste treatment (especially water purification)	Wetlands in drylands: biodiversity enables water purification service delivery
Erosion prevention	Conservation of vegetation diversity and rehabilitation of degraded vegetation cover prevents wind and water erosion, land degradation and desertification
Salinization prevention	Native deep-rooted vegetation keeps water tables, and salts, below plant root zones/land surface

Pollination, seed dispersal, biological control (e.g. pest and disease control)	Pollinators, e.g. bees; migratory birds; migratory herds and wild animals; predators of aphids and other pests
<b>Cultural Services: the non-material benefits obtained from ecosystems</b>	<i>Cultural and local identity in part determined by local environment and biodiversity</i>
Aesthetic information	Uniqueness of landscapes valued
Opportunities for recreation & tourism (e.g. natural reserves, World Heritage Sites)	Diversity of landscapes valued for different recreation activities; diversity of wildlife and unique endemic species is a major component of drylands tourism
Inspiration for culture, art and design	Iconic species and human cultures as inspiration for culture, art and design
Spiritual experience	Iconic species as inspiration for spiritualism, used in religious ceremonies
Information (e.g. cognitive development)	Education through diverse landscapes, habitats, species
<b>Supporting Services: services supporting the provision of other services</b>	<i>Biodiversity supports ecosystem service delivery and resilience</i>
Soil formation and maintenance	Dispersed plant clumps, with a variety of mosses and lichens, soil microorganisms, plus the movement of migratory herds, contribute to soil formation and maintenance
Photosynthesis Nutrient and water cycling	Biodiversity is important in primary production and in nutrient and water cycling

1 Typology adapted from the Millennium Ecosystem Assessment, 2005b; and TEEB, 2010a.

**Table 3:** Holistic TEV for biodiversity in drylands by land cover and land use: possible components

<b>Ecosystem Services</b>	<b>Cultivated land</b> <i>(Agriculture, agroforestry)</i>	<b>Grass and rangelands</b> <i>(Pastoralism)</i>	<b>Forests</b> <i>(Forestry, harvesting, pastoralism)</i>	<b>Water systems</b> <i>(Fishing, industry, energy, water provision)</i>	<b>Protected Areas</b> <i>(Tourism, conservation)</i>	<b>Other</b> <i>(Deserts, Urban)</i>
<b>DIRECT USE VALUES</b>						
<b>Provisioning, Cultural</b>	<ul style="list-style-type: none"> <li>• Agricultural sales, e.g. cash and food crops, agroforestry products</li> <li>• Subsistence products, e.g. food crops</li> <li>• Inputs to pastoralism (where agropastoralism is practiced)</li> </ul>	<ul style="list-style-type: none"> <li>• Livestock sales</li> <li>• Milk sales</li> <li>• Hides and skins sales</li> <li>• Subsistence products, e.g. milk and meat</li> <li>• Animal transport</li> <li>• Inputs to tourism, e.g. pastoralist culture</li> <li>• Inputs to agriculture, e.g. draught power, manure</li> </ul>	<ul style="list-style-type: none"> <li>• Timber sales</li> <li>• Sales of non-timber forest products, e.g. charcoal, honey, edible wild foods, basketry</li> <li>• Subsistence products, wood and non-wood products</li> <li>• Inputs to tourism, e.g. cultural values</li> <li>• Inputs to pastoralism, e.g. fodder, grazing</li> </ul>	<ul style="list-style-type: none"> <li>• Fish and fish product sales</li> <li>• Hydroelectric power sales</li> <li>• Water abstraction/consumption prices</li> <li>• Subsistence products from water bodies and wetlands</li> </ul>	<ul style="list-style-type: none"> <li>• Entry fees</li> <li>• Conservation project costs (species, landscapes)</li> </ul>	<ul style="list-style-type: none"> <li>• Desert product sales, e.g. dates, truffles</li> </ul>
<b>INDIRECT USE VALUES</b>						
<b>Regulating, Cultural</b>	<ul style="list-style-type: none"> <li>• Climate regulation</li> <li>• Water regulation (sustainable agriculture)</li> </ul>	<ul style="list-style-type: none"> <li>• Climate regulation</li> <li>• Water regulation</li> <li>• Nutrient cycling</li> <li>• Soil formation</li> <li>• Genetic resources</li> </ul>	<ul style="list-style-type: none"> <li>• Climate regulation</li> <li>• Water regulation</li> <li>• Nutrient cycling</li> <li>• Genetic resources</li> </ul>	<ul style="list-style-type: none"> <li>• Climate regulation</li> <li>• Disease regulation</li> <li>• Nutrient cycling</li> <li>• Waste treatment (e.g. water purification)</li> <li>• Genetic resources</li> </ul>	<ul style="list-style-type: none"> <li>• Climate regulation</li> <li>• Water regulation</li> <li>• Disease regulation</li> <li>• Soil formation</li> <li>• Waste treatment (e.g. carcass disposal)</li> <li>• Genetic resources</li> </ul>	<ul style="list-style-type: none"> <li>• Climate regulation</li> </ul>
<b>OPTION USE VALUES</b>						
<b>Provisioning, Regulating, Cultural</b>	Genetic diversity securing future potential use Ecosystem resilience securing future potential use					
<b>NON-USE VALUES</b>						
<b>Provisioning, Regulating, Cultural</b>	Altruistic value of someone else obtaining dryland ecosystem services Existence value derived from the knowledge dryland ecosystem services exist Bequest value from future generations benefiting from dryland ecosystem services					

## **Toolbox 2:** Useful references for TEV framework building for different aspects of drylands biodiversity

### **Drylands**

Mortimore, M. with contributions from S. Anderson, L. Cotula, J. Davies, K. Facer, C. Hesse, J. Morton, W. Nyangena, J. Skinner, and C. Wolfangel, 2009. *Dryland Opportunities: A new paradigm for people, ecosystems and development*. Gland: IUCN; London: IIED; Nairobi: UNDP.

Aboud, A.A., *et al.*, 2012. *Natural Resource Management and Biodiversity Conservation in the Drylands of Eastern and Central Africa*. Nairobi: ASARECA.

### **Agriculture**

Leakey, R.R.B., *et al.*, 1996. *Domestication and commercialization of non-timber forest products in agroforestry systems*. Rome: Food and Agriculture Organization. Available online at: <<http://www.fao.org/docrep/007/y5582e/y5582e07.htm>>.

Ma, S. and Swinton, S.M., 2011. Valuation of ecosystem services from rural landscapes using agriculture land prices. *Ecological Economics*, 70, pp. 1649-1659.

### **Pastoralism**

Hatfield, R. and Davies, J., 2006. *Global Review of the Economics of Pastoralism*. Nairobi: International Union for Conservation of Nature.

Association Non Gouvernementale à but non lucratif, 2007. *Valeurs économiques totales (TEV) du pastoralisme au Mali*. Kayes: World Initiative for Sustainable Pastoralism, Global Environment Facility, United Nations Development Programme, and International Union for the Conservation of Nature.

Rodriguez, L., 2008. *A global perspective on the total economic value of pastoralism: Global synthesis report based on six country valuations*. Nairobi: International Union for Conservation of Nature.

Behnke, R., 2010. *The contribution of livestock to the economies of IGAD member states study findings, application of the methodology in Ethiopia and recommendations for further work*. IGAD.

### **Forests**

Hassan, R.M. ed., 2002. *Accounting for stock and flow values of woody land resources: Methods and results from South Africa*. Pretoria: Centre for Environmental Economics and Policy in Africa (CEEPA), University of Pretoria.

Mobarghei, N., Liaghati, H. and Mohseni, A.S., 2010. *Estimating the water conservation value of forest ecosystems*. Tehran: Environmental Sciences Research Institute, University of Shahid Beheshti.

Ngugi, G., Newton, L.E. and Muasya, M., 2011. *The contribution of forest products to dryland household economy: The case of Kiang'ombe hill forest, Kenya*. *Ethnobotany Research & Applications*, 9, pp. 163-180.

### **Water systems**

Turpie, J., Ngaga, Y. and Karanja, F., 2005. *Catchment Ecosystems and Downstream Water: The Value of Water Resources in the Pangani Basin, Tanzania*. IUCN Water, Nature and Economics Technical Paper No. 7. Colombo: IUCN — The World Conservation Union, Ecosystems and Livelihoods Group Asia.

Chabala, L.M., *et al.*, 2012. *Assessing the Value of Land and Costs of Land Degradation in Zambia: First Draft Report*. University of Zambia, the Global Mechanism United Nations Convention to Combat Desertification and the Stockholm Environment Institute.

### **Protected areas**

Loomis, J. and Richardson, L., 2008. *Technical documentation of benefit transfer and visitor use estimating models of wildlife recreation, species and habitats*. Washington, D.C.: Defenders of Wildlife.

Turpie, J., Barnes, J., Lange, G.M. and Martin, R., 2010. *The economic value of Namibia's protected area system: A case for increased investment*. Ministry of Environment and Tourism Directorate of Parks and Wildlife Management.

### 3.4. STEP 4. SCENARIO-BUILDING: DESCRIBING BASELINES AND ALTERNATIVES; UNDERSTANDING DRIVERS OF CHANGE

The strength of economic analysis as applied to natural capital or biodiversity valuation is not so much that it creates a price for valuable public goods and services, but that when applied robustly and systematically, it gives a way to compare the flows of benefits under various states of that natural capital or biodiversity. The generic scenarios used to describe these various states typically include:

1. **Baseline.**<sup>48</sup> The TEV of biodiversity under status quo conditions (e.g. pristine, slow rate of loss, rapid rate of loss);
2. **Accelerated loss.** The TEV of biodiversity under a scenario of accelerated loss (e.g. new forest or agricultural plantation expansion, new infrastructure projects);
3. **Sustainable management.** The TEV of biodiversity under a scenario of policy intervention to conserve, reduce degradation of or improve biodiversity stocks (e.g. through completing a REDD+ project, implementing sustainable agricultural practices or enhancing economic incentives for better wildlife management).

The objective is to calculate and compare the TEV for biodiversity under each scenario and produce a comparison of likely socioeconomic impacts of different courses of action. Certainly, for restoration purposes, scenario building is a useful tool that can help assess the desired state of biodiversity (which may be different from, say, a “pristine” or pre-human-intervention state).

Typically, to bring this task down to manageable proportions, specific ecosystem services of particular interest are chosen as the focus of the study.

Approaches to assessing baseline biodiversity depends on the scope of the valuation project, but generally involve several field visits to undertake resource inventory mapping and categorization of land covers and uses, species diversity and populations and ecosystem service flows (see Toolbox 3 for more information).

For instance, establishing a baseline for a study with a relatively narrow scope (e.g. one community forest) could involve:

- Detailed biodiversity surveys;
- Mapping of local “uses” of the forest, noting places of spiritual significance;
- Surveying forest product consumption and trade in local households and markets;
- Assessment of impacts on local health and well-being of forest biodiversity and its loss; or
- Estimation of carbon stocks sequestered.

Conversely, a focus on an entire river system, or a protected area with diverse habitats, or total rangelands, may necessitate a selection of different biodiversity and economic indicators linked with productivity in key economic sectors, for example. For illustration, Box 12 summarizes the approach taken by Chabala *et al.* (2012) in valuing the Kafue River system in Zambia.

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48 The discussion refers to generic scenario building and intentionally keeps a broad focus rather than naming specific elements of the baseline.

**Toolbox 3:** Data sources for assessing biodiversity baselines

1. International indicators and databases on biodiversity:
  - Biodiversity Indicators Partnership (<http://www.bipindicators.net/indicators>)
  - ASEAN Centre for Biodiversity ([www.aseanbiodiversity.org](http://www.aseanbiodiversity.org))
  - World Resources Institute ([www.wri.org](http://www.wri.org))
  - Conservation International ([www.conservation.org](http://www.conservation.org))
  - BirdLife International ([www.birdlife.org](http://www.birdlife.org))
  - Diversitas International ([www.diversitas-international.org](http://www.diversitas-international.org))
  - Global Biodiversity Information Facility ([www.gbif.org](http://www.gbif.org))
  - International Union for Conservation of Nature ([www.iucn.org](http://www.iucn.org))
2. National-level indicators on biodiversity, livestock, area under cultivation
3. Commercial and non-commercial sources of satellite imagery
4. Rapid reconnaissance surveys in the locality
5. Scientific surveys of vegetation or wildlife species and coverage in the study locality
6. Direct interviews of households and local communities, e.g. pastoral communities. The role of indigenous knowledge in informing biodiversity and ecosystem service inventories should not be underestimated

**Box 12:** Description of a land-use system categorization for a valuation study of the Kafue River system, Zambia

Chabala *et al.* used the land-use system (LUS) as the basic unit of categorization. The delineation criteria for the LUS comprised the land cover type (e.g. forest, wetland, water bodies) and land-use type (e.g. urban, agricultural). An approximation of the spatial distribution of the land-use/cover types was created using existing topographic maps, Landsat TM images and ground-truthing. The images for the study area were then classified using a maximum likelihood algorithm in ILWIS 3.0. These were then exported to ARCGIS 9.2 in which a land-use/land cover map was created. The location of certain land-use classes such as hydro power generation was clearly identified and digitized using a physical map of Zambia at a scale of 1:50,000. Ground control points were collected from various locations in Kafue district, which were then used to improve the map of the land cover/land use for the study area.

Source: L.M. Chabala, E. Kuntashula, P. Hamukwala, B.H. Chishala and E. Phiri, 2012, *Assessing the Value of Land and Costs of Land Degradation in Zambia: First Draft Report* (University of Zambia, The Global Mechanism of the United Nations Convention to Combat Desertification and the Stockholm Environment Institute), p. 7.

***Assessing drivers of biodiversity loss to help in scenario development***

Assessing how natural capital stocks are likely to change in order to develop other scenarios for which comparative TEVs can be calculated requires an understanding of the drivers of biodiversity loss as well as their trade-offs (to avoid double counting). Davies *et al.* (2012) identify a range of indicators or drivers of biodiversity loss in drylands; drivers are summarized below in Box 13.

### **Box 13: Drivers of biodiversity loss in drylands<sup>1</sup>**

#### *1. Environmental*

**Land-use change:** Dryland biodiversity is undermined by unsustainable expansion of agriculture and the replacement of woodlands with crops and pasture due to government policies that favour crop production over traditional pastoralist activities. Poor understanding of the value of drylands has also allowed some countries to follow environmental policies of grassland afforestation, changing natural rangelands into unnatural woodlots.

**Biofuels:** High prices for biofuel crops have incentivized conversion of dryland pastoral lands to cultivation. Expansion of biofuel crops has the potential to eradicate poverty among poor dryland farming communities, but only if appropriate sustainable development measures are carefully implemented.

**Fragmentation:** Fragmentation of dryland ecosystems, as a result of agricultural development and road building, can have negative effects on native dryland plants and animals, leading to genetically isolated and reduced populations with higher propensity for inbreeding and extinction.

**Invasive alien species:** Global trade, transport and tourism are leading to a global homogenization of biodiversity, as species are moved into new and foreign areas.

**Intensification of unsustainable agricultural practices:** The intensification of unsustainable agricultural practices leads to loss of habitats, the introduction of invasive species, and water extraction levels that undermine the viability of native flora and fauna and lead to waterlogging or salinization.

**Overgrazing:** Overgrazing is cited as a significant factor in the loss of biodiversity and the breakdown of ecosystem services. There are numerous factors that influence overgrazing, but it is often simplistically attributed to overstocking.

**Climate change:** Climate change is predicted to reduce agricultural productivity in the drylands, with severe implications for food security. Populations that have adapted to survive in the drylands typically follow livelihood strategies that are highly dependent on local conditions.

**Erosion:** Drylands also face increased risk of erosion as a result of unsustainable agricultural practices and overgrazing, strip mining, vegetation damage by off-road vehicles, and in some areas, the impacts of war or oil pollution.

#### *2. Socioeconomic*

**Poor agropastoral policies:** In some cases, agropastoral policies fail to acknowledge the function that pastoralism plays in the management of drylands ecosystems, and fail to support pastoralism as both a viable livelihood and a contributor to wider ecosystem service maintenance provision.

**Rapid demographic change and urbanization:** Many drylands have doubled their resident populations in 30 to 40 years, with much of the growth taking place in urban areas, including small settlements. Urbanization rates within drylands have exceeded those outside drylands (4-16 percent in drylands compared with 3 percent outside drylands during the last forty years).

**Fire and biomass burning:** Fire provides many important services for maintaining drylands, but can also be harmful. When very hot and frequent, fire can destroy vegetation and increase soil erosion. Fire also releases atmospheric pollutants. Biomass burning, such as the burning of forests, savannahs, and agricultural lands after harvest, is recognized as a significant source of atmospheric emissions.

**Mining:** Mining activities can entail major excavation of soils and geologic formations, producing considerable environmental impacts. The health of human populations, as well as plants and animals in drylands, can be impaired by these activities.

**Demand for illegal wildlife and wildlife products:** International demand for rare or desirable wildlife and wildlife products motivates illegal trafficking and trade.

**Weak or weakening governance:** Governance is influenced by many factors, including social or political pressures, rising human populations and fragmentation of land. Weak or weakening governance, and particularly the undermining of customary institutions like indigenous protection without replacing them with effective alternatives, leaves drylands poorly or inappropriately managed.

<sup>1</sup> Summarized from information in Davies *et al.* 2012. *Conserving Dryland Biodiversity*. Nairobi: IUCN.

Table 4 provides a checklist of questions to help practitioners frame analyses on drivers of biodiversity loss in their study regions. Box 14 provides an example of how indicators may be used in wildlife utilization policies.

**Table 4:** Key drivers of biodiversity loss in dry and sub-humid lands: A checklist

<b>Drivers</b>	<b>Questions</b>
<i>Land-use change</i>	What land-use change patterns are observed in the study area? Are they likely to have impacts on biodiversity quality or quantity?
<i>Biofuels cultivation</i>	Are biofuel crops being cultivated? What is the land coverage and the rate of expansion? Is it irrigated or rain-fed cultivation?
<i>Fragmentation</i>	Fragmentation of dryland ecosystems, as a result of agricultural development and road building, can have negative effects on native dryland plants and animals, leading to genetically isolated and reduced populations with higher propensity for inbreeding and extinction.
<i>Invasive alien species</i>	Global trade, transport and tourism are leading to a global homogenization of biodiversity, as species are moved into new areas that are foreign to them.
<i>Intensification of unsustainable agricultural practices</i>	Agricultural policy? Indicators for expansion of unsustainable agricultural practices (e.g. water abstraction rates)?
<i>Overgrazing</i>	Restrictions in herd mobility? Incentive measures concerning livestock add-ons, take-offs?
<i>Poor agropastoral policies</i>	Is pastoralism viewed positively or negatively in national policies? How is sustainability integrated into agricultural policy?
<i>Rapid demographic change and urbanization</i>	What are the rates of population growth in the study region?
<i>Climate change</i>	Indicators of climate change developed?
<i>Fire and biomass burning</i>	Presence of biomass burning after harvests? Indicators of air quality?
<i>Mining</i>	Mining activities present? Direct and non-direct impacts?
<i>Erosion</i>	Erosion present or drivers of erosion: unsustainable agricultural practices and overgrazing, strip mining, vegetation damage by off-road vehicles, and in some areas, the impacts of war or oil pollution.
<i>Illegal trade</i>	Is there documented evidence of illegal trade of wildlife or wildlife products? What is the estimate of global demand for such products?
<i>Governance</i>	Existence and effectiveness of legislation relevant to biodiversity protection in dry and sub-humid zones? Are land rights or concessions well described and recognized? How can institutional capacities be characterized – weak, strong? What role is there for traditional institutions? Do these institutions function? Is this role changing?

### **Box 14:** Case study synopsis: Wildlife utilization policies in Kenya

#### **The Future for Wildlife on Kenya's Rangelands: An economic perspective**

Prior to 1977, wildlife conservation policy in Kenya was very broad-based. It included complete preservation within the protected areas; live capture for sale and export; ranching, cropping and culling; tanning, taxidermy and curios; and sport hunting within both long-term and short-term concession areas and hunting blocks. The consumptive wildlife industry went from being worth an estimated \$20 million in 1977 to an estimated \$600 million today.

In an abrupt policy change in 1977 all hunting was banned and in 1978 a complete ban was issued on all other consumptive utilization (live capture and sales, cropping, ranching, manufacture of trophies and curios). After this date the sole use to which wildlife could be put was game viewing.

By the early '90s there were indications that wildlife outside of the protected areas were in decline (Brotten and Said 1995, de Leeuw *et al.* 1998, Norton-Griffiths 1995, 1996; Ottichilo *et al.* 2000, 2001; Sinclair 1995).

In 1992, seeking to improve matters, the newly created Kenya Wildlife Service (KWS) started to reinstate wildlife-related benefits to landholders by permitting consumptive utilization (reduction cropping) on ranches infested with wildlife. Eventually some 60 wildlife cropping, ranching and farming operations were licensed and game meat products could be sold on the open market. The KWS also encouraged neighbouring landholders to form licensed Wildlife Associations and Wildlife Forums to jointly manage their wildlife, much as neighbouring landholders do throughout southern Africa and Europe.

The new Community Wildlife Service of the KWS also started to provide tangible benefits to landholders by disbursing a proportion of gate receipts to communities living around the protected areas as Wildlife Development Funds for social investment (Berger 1993). They also began to assist landholders to negotiate more advantageous concession fees with tourism operators and to set up their own privately financed tourist operations such as campsites, tented camps and camel trekking.

Although returns from the cropping were low, typically around \$0.5 per hectare per year (Norton-Griffiths and Butt 2006), they were enough to encourage a benign attitude towards wildlife by landholders and especially to ignore some development options. Specifically, it was not so much the earnings that were important but the increase in ranch profitability following the reduction in wildlife numbers (e.g. Norton-Griffiths *et al.* 2008). However, all cropping activities were again abruptly terminated in 2003.

Despite all these efforts, by the mid '90s it was becoming clear that some 50 percent of wildlife had been eliminated from the ASAL [arid and semi-arid land] rangelands. The only good news was that loss rates seemed to be lower within the protected areas than outside (Norton-Griffiths 1998). However, more recent analyses (Western *et al.* 2007) show that the loss rates have continued unabated and that losses are equally bad both inside and outside protected areas. Effectively, some 70 percent of all large wildlife have now (2007) been eliminated from the protected areas and rangelands of Kenya, despite the literally hundreds of millions of dollars spent on conservation efforts by international donors, conservation NGOs and the Government of Kenya. This is a terrible indictment of conservation policy and evidence of a massive failure by all concerned (Norton-Griffiths 2007).

Even in the mid-90s the analysis of loss rates suggested a strong underlying economic component (Norton-Griffiths 1998). Losses, for example, were lower on adjudicated land (group ranches) than on unadjudicated land; and were lower where tourists visited than where they did not visit. Furthermore, where wildlife revenues went more clearly and transparently to landholders (group, communal or private) rather than to central government, then wildlife was either holding its own or perhaps even increasing.

The recent analyses of Western *et al.* (2007) confirm these earlier analyses. Today, the only places where wildlife has held its own or actually increased are on large, private landholdings and private conservancies, or on group ranches savvy enough to strike profitable contracts with tour operators.

Source: Text taken from Norton-Griffiths and Said, 2009.

### 3.5. STEP 5. IDENTIFYING KEY VALUES AND BENEFICIARIES UNDER DIFFERENT SCENARIOS

Following the TEV framework, it is worthwhile to look at the range of values of interest so that all beneficiaries of note are included in the analysis. Table 3 above provides examples of the types of values for biodiversity in dry and sub-humid regions that can be estimated and how they relate to the four ecosystem service categories.

For the execution of the TEV analysis, some of the main elements that need to be focused on are as follows:

- a) Who benefits from sustainable use of dry and sub-humid lands biodiversity and ecosystem services; and
- b) Who bears the cost of the deterioration; and conversely
- c) Who in turn benefits from degradation (e.g. illegal trade of wildlife) (see Box 15); and
- d) Who loses out under conservation scenarios (e.g. reduced herd mobility for pastoralists).

Broadly, the populations of interest for the analysis are those who hold use and non-use values for:

1. Direct consumption of drylands products, including those which have been transformed further down value chains (e.g. water, pastoral products, dry forest products, ingredients for cosmetics);
2. Direct non-consumptive benefit of dry and sub-humid land resources (e.g. water, recreation or wildlife safaris);
3. Climate regulation and other indirect use ecosystem services provided by dry and sub-humid land covers; and
4. Intrinsic worth for dry and sub-humid landscapes and species, i.e. existence, bequest and altruistic values.

#### **Box 15: Black market trade of wildlife and wildlife products**

Benefits derived from illegitimate uses of dry and sub-humid lands biodiversity, for example, the value of illegal wildlife and wildlife product trade, should only be included as a benefit in the TEV analysis of unsustainable use of biodiversity scenarios.

The Coalition Against Wildlife Trafficking reports that the illegal trade in wildlife and wildlife products is a soaring black market worth an estimated \$10 billion a year. Unchecked demand for exotic pets, rare foods, trophies and traditional medicines is driving many species to the brink of extinction, threatening efforts to meet the global 2010 target to reduce biodiversity loss, and contributing to the spread of virulent wildlife diseases to humans. (<http://www.cawtglobal.org/wildlife-crime/>)

WWF reports that illegal wildlife trade can cause overexploitation that harms human livelihoods. Wildlife is vital to the lives of a high proportion of the world's population, often the poorest. Some rural households depend on local wild animals for their meat protein and on local trees for fuel, and both wild animals and plants provide components of traditional medicines used by the majority of people in the world. Many people in the developing world depend entirely on the continued availability of local wildlife resources. ([http://wwf.panda.org/about\\_our\\_earth/species/problems/illegal\\_trade/](http://wwf.panda.org/about_our_earth/species/problems/illegal_trade/))

In a 4 December 2012 news report by Reuters and run in Scientific American, the Wildlife Conservation Society (WCS) reports that the once-thriving elephant population of South Sudan could be wiped out in five years if rampant poaching is not brought under control. After decades of civil war, the African country, which became independent last year, has fewer than 5,000 elephants left, down from around 130,000 in 1986. Driven by demand from China, the price of ivory has quadrupled in the last few years, according to Paul Elkan, South Sudan Director at WCS. 2011 was apparently the worst year on record for poaching worldwide, with 24 tons of ivory seized. (<http://www.scientificamerican.com/article.cfm?id=south-sudans-elephants-could-be-wiped>)

Tools that may be helpful in mapping beneficiaries include:

- Value chain analysis, or supply chain analysis (see Toolbox 4), which looks at the sequence of activities required to make a product or provide a service;
- Local, regional, national, interregional and global stakeholder analysis (see step 2 above), including shareholders or downstream/global consumers.

#### **Toolbox 4:** Value chain analysis: Guidance and examples

AM Partners Consulting Company, 2010. *Analysis of processors and traders involved in value chain of selected biodiversity products in Armenia; Report*. [pdf] Available at: <<http://www.ampartners.am/files/publications/1280487223.pdf>>.

Bournes, N., 2009. *Adding biodiversity conservation objectives to a value chains and rural finance initiative: The AFIRMA project experience in Mexico*. United States Agency for International Development. [pdf] Available at: <[http://pdf.usaid.gov/pdf\\_docs/PNADW230.pdf](http://pdf.usaid.gov/pdf_docs/PNADW230.pdf)>.

Holcim Group Support and IUCN, 2009. *Biodiversity-based microenterprise development (B2MD)*. [pdf] Available at: <<http://cmsdata.iucn.org/downloads/b2md.pdf>>.

Schmitz, H., 2005. *Value chain analysis for policy-makers and practitioners*. Geneva: International Labour Organization. [pdf] Available at: <[http://www.fao.org/fileadmin/user\\_upload/fisheries/docs/Value\\_Chain\\_ILO.pdf](http://www.fao.org/fileadmin/user_upload/fisheries/docs/Value_Chain_ILO.pdf)>.

Te Velde, D.W., Rushton, J., Schreckenber, K., Marshall, E., Edouard, F., Newton, A. and Aranciba, E., 2006. Entrepreneurship in value chains of non-timber forest products. *Forest Policy and Economics*. 8(7), pp. 725-741.

Will, M., 2008. *Promoting value chains of neglected and underutilized species: for pro-poor growth and biodiversity conservation; Guidelines and good practices*. Rome: Global Facilitation Unit for Underutilized Species. [pdf] Available at: <[http://www.underutilized-species.org/documents/PUBLICATIONS/promoting\\_vc.pdf](http://www.underutilized-species.org/documents/PUBLICATIONS/promoting_vc.pdf)>.

### **3.6. STEP 6. MAPPING DATA REQUIREMENTS FOR A TEV ANALYSIS**

A necessary step in designing TEV studies is to understand what data are required to perform a TEV analysis, where existing data can be sourced cost-effectively, and what new data need to be generated. As TEV covers both market and non-market values, TEV analysis will require gathering quantified data, e.g. estimates of livestock numbers, hectares of forest land, estimated carbon sequestration per hectare of grasslands (and monetary estimates<sup>49</sup> where these are available), as well as monetary data readily available on commodities markets, for example. By way of illustration, Table 5. TEV framework for biodiversity and pastoralism in drylands: information required<sup>15</sup> maps the information required for capturing TEV of pastoralism.

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<sup>49</sup> Where possible, it would be useful to have monetary estimates harmonized to enhance evaluation (e.g. in US\$).

**Table 5: TEV framework for biodiversity and pastoralism in drylands: information required<sup>1</sup>**

<b>Direct use values</b>	<b>Information required – quantified or monetized</b>
<i>Livestock sales</i>	Which price should be used – price to the producer, or at the end market?
<i>Milk sales</i>	Triangulate data sources with case study, and separate subsistence milk use from that which is marketed.
<i>Hides and skins sales</i>	Case studies to estimate subsistence meat/milk/blood use, informal transfers of animals for slaughter (including ceremonies), value of hides and skins in subsistence. Methodological question over valuing the subsistence economy – whether to use market value of a good or a replacement or proxy value
<i>Subsistence products</i>	Case studies to estimate subsistence meat/milk/blood use, informal transfers of animals for slaughter (including ceremonies), value of hides and skins in subsistence. Methodological question over valuing the subsistence economy – whether to use market value of a good or a replacement or proxy value
<i>Transport income</i>	Estimate incomes from transport and other livestock services
<i>Employment</i>	Labour costs for pastoralism not yet calculated (could be done in the same way as for cultivation-based agriculture – labour inputs for herding and livestock management, labour inputs for other household activities)
<i>Social capital</i>	Estimates of insurance or social security conferred, predominantly qualitative except for asset values reflecting possibilities for accessing credit.
<i>Transport service</i>	Use a substitution value (kilometres travelled per year multiplied by a vehicle rental costs from the same sort of services). Could be subsumed within the system as a production cost, but much of the transportation is for household consumption – other systems would not subsume such costs under production.
<b>Indirect use values</b>	<b>Information required – quantified or monetized</b>
<i>Inputs to tourism</i>	Direct revenue accrued from tourism to people, groups and local governments (including benefit sharing). Opportunity costs of pastoral land lost for reserves (parks, forests etc.). Supplementary incomes generated from tourism through the use of pastoral culture and heritage
<i>Inputs to agriculture</i>	Manure; traction (cultivation, water, fodder, other goods); need to segregate traction (an input to agriculture) from transport (an input to the household). With fodder valuation, attention needs to be paid to the risk of double counting as fodder is valued as an input to livestock production.
<i>Forward and backward linkages to the economy</i>	The effects of secondary spending in the economy based on pastoralist-generated income from livestock (e.g. shops selling radios, products so that the monies are recycled out of pastoralism). This includes expenditure on goods and services by pastoralists, value added in the production chain and subsequent expenditures by those in related industries.
<i>Taxes and levies</i>	Tax revenues can be assessed from local and national records, although records may be weak due to corruption.
<i>Inputs to dryland products</i>	Provision of labour, manure, improving water and mineral cycling. Such environmental services lead to locally captured benefits that may be hard to quantify unless comparison is made between areas under different grazing arrangements. Dryland products include aloes, sisal, honey, incense, gum, henna, dyes, medicinal plants, plus a range of provender (wild foods) and forest products. It can be difficult to know how to attribute the benefits from these products as it depends on whether it is the productive value of the ecosystem or who the beneficiary is that is being evaluated.
<i>Ecological and rangeland services</i>	Protecting and enhancing watersheds. Carbon sequestration (perhaps an option value) potential – can be calculated based on IPCC (Intergovernmental Panel on Climate Change) findings for different land-use systems and vegetation types. Cost of desertification and value of pastoralism in averting it
<i>Agricultural services</i>	“Financial” role of livestock towards agriculture. In group ranches there may be data on loans issued against livestock
<i>Global goods</i>	Value of dryland natural resources, biodiversity, and scenery. Value of system resilience and risk managing and coping strategies.
<i>Socio-cultural values</i>	As perceived by pastoralists
<i>Genetic resources</i>	Data on how much people/institutions are willing to pay to preserve rare animal breeds
<b>Option use values</b>	<b>Information required – quantified or monetized</b>
<i>Genetic resources</i>	Contribution of preserving rangelands, grasslands – and managing them well through appropriate pastoral and other activities – to biodiversity conservation. Data on how much people/institutions are willing to pay to preserve rare breeds for offsetting future unknown risks.
<b>Non-use values</b>	<b>Information required – quantified or monetized</b>
<i>Genetic resources</i>	Contribution of preserving rangelands, grasslands – and managing them well through appropriate pastoral and other activities – to biodiversity conservation. Data on how much people/institutions are willing to pay to preserve rare breeds for existence values.

<sup>1</sup> Adapted from information in Davies, 2007.

### 3.7. STEP 7. VALUATION: MARKET AND NON-MARKET APPROACHES

This discussion gives an overview of valuation methods relevant to estimating the economic contribution of biodiversity in dry and sub-humid lands. There are other equally valid approaches to assessing benefits as well, such as bio-economic modelling of joint production of ecosystem services, which while useful, require a great deal of time and information to be done well. Table 6 lists some market and non-market valuation approaches used to capture different dimensions of value required to calculate a TEV of a resource; we discuss some additional approaches as well (e.g. benefits transfer, non-monetary and cultural valuation, multi-criteria analysis).

**Table 6:** Relationships between valuation methods and value types

Approach	Method	Value	
<b>Market Valuation</b>	<i>Price-based</i>	Market prices	Use value (direct and indirect)
	<i>Cost-based</i>	Avoided cost	Use value (direct and indirect)
		Replacement cost	Use value (direct and indirect)
		Mitigation/Restoration cost	Use value (direct and indirect)
	<i>Production-based</i>	Production function approach	Use value (indirect)
		Factor income	Use value (indirect)
<b>Revealed preference</b>	Travel cost method	Direct (indirect) use value	
	Hedonic pricing	Use value (direct and indirect)	
<b>Stated preference</b>	Contingent valuation	Use and non-use value	
	Choice modelling/Conjoint analysis	Use and non-use value	
	Contingent ranking	Use and non-use value	
	Deliberative group valuation	Use and non-use value	

Source: TEEB, 2010a (Chapter 5)

#### 3.7.1. Market valuation methods

Market valuation techniques are used to estimate direct and indirect use market value of ecosystem services; examples of methods are listed in Table 7. The strength of these methods is that they rely on actual market prices. The weakness is that these prices may not reflect the full costs or benefits of the ecosystem service being valued. Furthermore, poor data quality, limited data availability and fragmented categorizations of economic sectors pose challenges.

#### *Market-based approaches*

Market-based approaches estimate the value of an ecosystem as equivalent to its ecological yield using local or global commodity markets prices, value of labour employed, asset valuations (e.g. value of livestock herds, value of dryland product exports). The markets of interest in a drylands context may be local rural, urban, regional or international markets, depending on the country and the marketed products being included in the TEV.

#### *Cost-based approaches*

Cost-based approaches estimate costs reduced or avoided through the functioning of biodiversity/ecosystem services. For instance, when ecosystems are degraded or lost, their services would need replacement by costly human-made technology (replacement cost), or would eventually need to be restored (restoration cost). These are pragmatic estimations based on real market prices, even though it needs to be understood that cost-based approaches do not estimate value per se. Using costs as a proxy can be appropriate in some decision-making problems, for instance when the problem consists in identifying the least-cost option among different policy

options. However, one important limitation is the potentially very partial nature of the estimation. For instance, when calculating replacement costs, there is a question as to whether or not the natural services can be replaced fully by human-made technologies, i.e. does the replacement service contribute to the full range of ecosystem functioning of the natural service?

### ***Production function approaches***

Production function approaches estimate how much a given biodiversity asset or ecosystem service (e.g. regulating service) contributes to the delivery of another service or commodity which is traded on an existing market. Input of biodiversity into mean agricultural productivity is an important production function relevant for biodiversity valuation in drylands. Identifying relationships between biodiversity, ecological functioning and ecosystem services is a significant challenge for production function methods. Indeed for such approaches to contribute effectively towards achieving sustainable development it is essential that understanding go past negative trade-offs between biodiversity and production. For example, today while monocultures are perceived as being best for production, diverse systems are acknowledged for their importance in conservation and should be encouraged.

Selection of market valuation methods depends on:

- Availability, quality and reliability of information, or ability to generate the required information;
- Cost of obtaining commercial data;
- Certainty, or at least reasonable assumptions, for attributing a percentage of market values to the underlying biodiversity assets or ecosystem services;
- Price and quality of alternative methods as well as the market price method itself.

The individual context will determine what the best approach to valuation is, depending on what exactly is being valued and the information availability. Practitioners are required to make the choice of valuation method on a case by case basis.

**Table 7:** Overview of market valuation methods

<b>Description</b>	<b>Examples of methods</b>
<i>Market-based approaches</i>	<ul style="list-style-type: none"> <li>• Global commodity exchange prices</li> <li>• Natural resource rent valuation</li> <li>• Market price surveys at the local level to value subsistence consumption</li> <li>• Asset appraisal valuations, e.g. pastoral herds</li> <li>• Value-added calculation, e.g. transformation of forest wood products like charcoal</li> <li>• Export value, e.g. interregional trade of livestock, export of artisanal products</li> <li>• Number of jobs, value of labour, e.g. national minimum wage, average agricultural wages</li> </ul>
<i>Cost-based approaches</i>	<ul style="list-style-type: none"> <li>• Costs of mitigation or defensive expenditures, e.g. flood barriers or embankment building, relocation</li> <li>• Cost of restoration/rehabilitation, e.g. landscape restoration post mining closure, rehabilitation of forests</li> <li>• Cost of replacement, e.g. water treatment and purification, import of food and bottled water.</li> <li>• Cost of illness method, e.g. market cost of medical treatment otherwise met by medicinal plants, lost income from illness</li> <li>• Costs of children's environmentally attributable illnesses, e.g. from lack of access to clean water</li> </ul>
<i>Production function approaches</i>	<ul style="list-style-type: none"> <li>• Input to the productivity of any marketed output from an economic activity in one time period (static production function)</li> <li>• Input to the productivity of any marketed output from an economic activity in multiple time periods (dynamic production function)</li> </ul>

### 3.7.2. Non-market valuation methods

Non-market valuation techniques are used to estimate the value of biodiversity and ecosystem services that are normally unpriced, and that fall under the indirect use, non-use and option value categories (Box 7. The four dimensions of value as measured by economists<sup>7</sup>). They include revealed preference and stated preference techniques (Table 8).

#### *Revealed preference approaches (e.g. travel cost, hedonic)*

Revealed preference approaches **involve observation of individual choices in existing markets** related to the ecosystem service that is the subject of valuation. For instance, analysts can use change in property prices to proxy the change in environmental quality in a particular locality (*hedonic price method*), or the costs of travel, time taken away from work and entrance fees can all be used to say something about the value of a national park to those who visit it (*travel cost method*). In revealed preference techniques, it is said that economic agents “reveal” their preferences (that is, their willingness to pay) through their choices. A World Bank study on the cost of environmental degradation in Lebanon and Tunisia made reference to having used these methods.<sup>50</sup>

Revealed preference approaches have the advantage that, like market-based approaches, they use real prices that reflect real preferences. However, when this information is unavailable (or expensive to obtain), or when the relationship between the environmental attribute and the observed market behaviour is uncertain, these techniques are limited.<sup>51</sup>

#### *Stated preference approaches (e.g. survey-based)*

Stated preference approaches directly question a representative set of respondents by means of surveys on hypothetical (policy-induced) changes in the provision of ecosystem services. Stated preference techniques **are based on hypothetical rather than actual behaviour**, where people’s responses to questions describing hypothetical markets or situations are used to infer value. These methods can be used to estimate both use and non-use values of ecosystems.

- a) *Contingent valuation method (CVM)*: A common example of stated preference technique; it uses questionnaires to ask people how much they would be willing to pay (WTP) on their own behalf to avoid the loss or increase the provision of an ecosystem service. In some situations, researchers may also inquire about the willingness to accept (WTA), that is, the minimal compensation an individual would require in order to forgo the provision of (a certain amount of) an ecosystem service. However, WTP is generally preferred, one reason being that, unlike WTA, WTP is constrained by an individual’s (hypothetical or actual) wealth and hence less prone to respondent bias.<sup>52</sup>
- b) *Choice modelling (CM)*: Choice modelling allows the capture of trade-offs between different ecosystem services. It attempts to model the decision process of an individual in a given context given two or more alternatives with shared but different attributes, with a price factor being one of the attributes.
- c) *Group valuation*: Combines stated preference techniques with elements of deliberative processes from political science to capture value types that may escape individual based surveys, such as value pluralism, incommensurability, non-human values, or social justice.

Stated preference techniques are the only method for capturing non-use values, but even with well-designed surveys, it is uncertain if respondents’ hypothetical choices would translate to the same behaviour faced with real costs. When it comes to valuing “bundled” ecosystem services, stated preference methods that aim to capture

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50 See Aboud *et al.*, 2012.

51 See Diamond, 1996; Diamond and Hausman, 1994; Carson *et al.*, 2001; Boyce *et al.*, 1992; Brown, 2005.

52 See Arrow *et al.*, 1993.

total economic value of ecosystems are thought to overcome the problem of having to add separate values for ecosystem service values.<sup>53</sup>

However, there are also a number of theoretical and technical questions regarding the validity of CVM and CM results, including:

- A range of possible biases in respondents' replies;
- The need to ensure representativeness of the sample of respondents; and
- The need to ensure that respondents are well-informed about the issue under consideration.

The latter point is particularly relevant in the present context. Ensuring that respondents understand well the concept and importance of ecosystem services and the intricate and complex linkages between biodiversity, ecosystem functioning, and ecosystem services may pose considerable challenges to the researcher.

In general, as stated preference techniques are based on hypothetical behaviour (as opposed to the actual, observed behaviour) of individuals, they are inherently less reliable than revealed preference or market valuation methods. Consideration should be given to use of stated preference techniques whenever non-use values are deemed to be of particular importance in a specific decision-making problem.<sup>54</sup>

Selection of non-market methods depends on:

- Capacity to design and conduct non-market valuation studies, including technical capacity and the financial resources required for preparing such analyses;
- Cost-effectiveness, i.e. will CVM and other non-market methods capture the values of interest or will cultural valuation exercises improve the analysis demonstrably.

**Table 8:** Overview of non-market valuation methods

Description	Examples of methods
Revealed preference approaches	Travel cost method Hedonic price analysis Averting behaviour method
Stated preference approaches	Contingent valuation method Contingent ranking method Choice experiments Conjoint analysis Group valuation

### 3.7.3. Other techniques

#### *Benefits transfer*

Benefits transfer is a method that estimates economic values for ecosystem services by transferring results from valuation studies completed in other contexts. Existing or "standardized" estimates for land productivity (e.g. per hectare timber production for dry forests, per hectare livestock headage), perhaps organized by country or region, or non-market valuation results (e.g. estimated average value of carbon sequestration in savannah grasslands) can be used instead of generating estimates for new studies.

<sup>53</sup> Quillérou and Thomas, 2012.

<sup>54</sup> DeFries and Pagiola, 2005, section 2.3.3.1.

Benefits transfer is a low-cost method of obtaining use and non-use values that is practical and effective in some contexts. However, if taken from studies that are not well matched with the valuation objective, or if the results are not weighted or transformed appropriately, the resulting valuation will be of poor quality. Availability of appropriate, good quality studies for use in benefits transfer analyses determines how appropriate a technique it is for a new analysis, and there is always a risk when extrapolating from data garnered in one context but applied in another.

### ***Valuation without monetization***

Valuation does not necessarily imply monetization, and there are important values that cannot be reduced to such terms. Valuation without monetization is a much overlooked aspect of valuation that elicits useful preference information for non-material values and cultural ecosystem services for which monetization is not always appropriate. Interest in these techniques and examples of their application are increasing, though integration into policy analysis tools may prove challenging.

### ***Cultural valuation***

This valuation technique relies on articulation of preferences through ranking or qualitative statements, and tracking spatial use and occupancy to elicit the values people hold for recreation, wildlife, spiritual or sacred sites and locations important to stakeholders' cultural heritage. Though still informative for land-use planning, there are some caveats to these methods. With respect to valuing landscapes or species of cultural significance, frequency of "use" or visits to the location are not necessarily good indicators of value.<sup>55</sup> Moreover, communicating nonmonetary values so that they can be integrated into decision-making processes is challenging<sup>56</sup> (see Toolbox 5).

#### **Toolbox 5: Resources on cultural valuation**

Living Proof: The Essential Data-Collection Guide for Indigenous Use-and-Occupancy Map Surveys. Available (to order) at: <http://www.ubcic.bc.ca/livingproof/index.html#ixzz2EH0CVvza>

Daniel, T.C., *et al.*, 2012. Contributions of cultural services to the ecosystem services agenda. *PNAS*, 109(23), pp. 8812-8819

Chan, K.M.A., *et al.*, 2012. Where are cultural and social in ecosystem services? A framework for constructive engagement. *BioScience*, 62(8), pp. 744-756

Klain, S.C. and Chan, K.M.A., 2012. Navigating Coastal Values: Participatory mapping of ecosystem services for spatial planning. *Ecological Economics*, 82: 104-113.

### ***Multi-criteria analysis***

Multi-criteria analysis (MCA) is a family of methods that use various scoring approaches to weigh the different attributes of a decision. They are used to structure a policy problem in terms of possible policy alternatives and to assess each alternative under various criteria. MCA is mainly applicable to cases where a single-criterion approach is insufficient. Instead, an MCA may accommodate a range of social, environmental, technical, economic, and financial criteria. MCA is therefore applicable especially where significant environmental and social impacts are present which cannot (easily) be expressed in monetary terms.

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55 T. Wiens, [tsw.web@gmail.com](mailto:tsw.web@gmail.com), 2012, [Marxan] Value of biodiversity in dry and sub-humid lands: Looking for studies [email] Message to L. Gallagher ([louise@lgallagher.com](mailto:louise@lgallagher.com)) Sent 11 November 2012, 6:05 [Accessed 11 November 2012].

56 See Klain and Chan, 2012.

Their attractiveness lies in the fact that the use of such techniques avoids the need to place monetary values on all impacts for them to be explicitly taken into account in an assessment. In this sense, they are often viewed as being more flexible than economic appraisal methods and applicable to a wider range of social and environmental issues.<sup>57</sup> Economists contend, however, that these techniques are inferior to economic appraisal methods because they provide no indication of whether the benefits of an action outweigh the costs in resource terms.<sup>58</sup> There are very few applications of MCA in developing countries because of the wealth of information required.<sup>59</sup>

### ***Deliberative and participatory approaches***

These methods are aimed at creating better-informed decisions that are owned by all relevant actors and stakeholders and that have their broad consent. In many countries, the benefits emanating from some ecosystem services are well known to local and indigenous communities – this is captured by their traditional knowledge. If these communities are adequately included in economic valuation exercises, the value they put on these ecosystem services can be captured by economic valuation. However, traditional knowledge of ecosystem services is often not adequately received by the wider public. Here, deliberative and participatory approaches may play an important role in promoting the wider recognition of this knowledge.

The use of economic information in these methods is entirely at the group's discretion. Valuation data may or may not consistently inform the outcome of such processes, and they cannot guarantee that outcomes are an efficient use of public resources.

### ***Habitat equivalency analysis***

In the case of potential natural resource injuries from accidental events, government agencies need to evaluate economic damage estimates under alternative scenarios. However, accurate damage estimates are often difficult to obtain because of a lack of data on the ex ante economic costs of natural resource injuries. In recent years, trustees have increasingly used habitat equivalency analysis (HEA) to scale compensation for natural resource injuries.

Unlike traditional economic analysis, which bases damage estimates on losses to human use (and sometimes non-use) values, HEA estimates the ecological service loss of the injury and then scales restorative ecological compensation to offset these losses. HEA aims to maintain a baseline level of ecological functioning rather than a baseline level of human welfare.<sup>60</sup> The biggest concern with this valuation method is the fact that this has more relevance when accidents have already occurred, and therefore is of more limited use when one tries to prevent such accidents from occurring.

### ***Checklists and trend analysis***

Checklists can be used to provide quick indicators of the potential implications of a proposed policy. They can be used at a preliminary level to identify potential impacts, and so may complement or form part of an overall approach based on cost-benefit analysis (CBA), discussed below. Alternatively, checklists may be used instead of economic appraisal methods to provide a more readily applied means of indicating likely impacts. Similarly, trend analysis can provide an immediate overview of likely impacts. Such analyses also provide some indication of significance.

These methods can be criticized in that they do not provide an indication of the relative significance of impacts falling under different headings. As a result, they provide less information than CBA.<sup>61</sup>

57 Gamper and Turcanu, 2007.

58 Virani and Graham, 1998.

59 Ibid.

60 Roach and Wade, 2006.

61 Virani and Graham, 1998.

### **3.8. STEP 8. AGGREGATING RESULTS ACROSS TYPE OF VALUES AND SERVICES: THE RISK OF DOUBLE COUNTING**

As mentioned in step 3 on developing a TEV framework, TEV is the sum of all benefits obtained from a resource:  $TEV = \text{use value (direct and indirect)} + \text{option value} + \text{non-use value (bequest + altruistic + existence value)}$ . One concern in aggregating values is avoiding double counting of benefits that are integral to other benefits. Moreover, some ecological functions may be mutually exclusive. For instance, valuing a forest by simply adding both its economic potential for charcoal production and timber and its carbon storage services would overstate the carbon benefits to be derived.

When it comes to valuing “bundled” ecosystem services (such as services provided by standing forests, including water recycling and purification as well as carbon sequestration, amongst others), if different ecosystem services can be identified which are not dependent on each other, then calculating different, independent ecosystem services and summing them is the best approach. If, however, the services are interdependent, stated preference methods that aim to capture total economic value of ecosystems are thought to overcome the problem of having to add separate values for ecosystem service values.<sup>62</sup> Another solution is to assign weights to individual components for aggregation as derived using multi-criteria analysis or participatory approaches with experts and other stakeholders. This provides a way to reflect social preferences and the state of current scientific knowledge.<sup>63</sup>

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62 Quillérou and Thomas, 2012.

63 Ibid.

## 4. USING VALUATION INFORMATION IN POLICYMAKING

Policymaking has evolved towards inclusive and participatory decision-making with a stronger focus on stakeholder impacts and rights, showing the growing importance of following a well-rounded, informed decision-making process.

The goal of biodiversity valuation is ultimately to be able to compare policy outcomes pertaining to biodiversity conservation approaches, agropastoral policy, watershed management, land development, etc. These comparisons, as well as the ability to set out the full range of hidden costs of biodiversity loss, can contribute towards more informed decision-making.

More specifically, biodiversity valuation within drylands can help to:

- Bridge the science-policy gap in understanding:
  - Say something meaningful about what changes in drylands biodiversity mean for the people who make their livelihoods, receive sustenance and nutrition or derive cultural or spiritual meaning from drylands biodiversity;
  - Track some changes that are not being monitored; and
  - Help provide appropriate solutions to current socioeconomic problems being experienced in dryland environments;
- Improve policy analysis and decision-making concerning biodiversity conservation in dry and sub-humid lands, particularly including decision-making related to land use and rights;
- Improve understanding of the links between dryland biodiversity and national GDP, or other measures of wealth and well-being;
- Design better legal and economic policy instruments, including sustainable financing measures.

### 4.1. POLICY ASSESSMENT PROCEDURES FOR BIODIVERSITY-RELATED POLICIES

TEV information can contribute to policy assessment procedures for:

- a. Policies specifically for biodiversity conservation in dry and sub-humid lands (e.g. national action strategies for biodiversity conservation, or accession to or implementation of a biodiversity-related multilateral environmental agreement);
- b. Policies that will affect biodiversity in dry and sub-humid lands, i.e. agricultural policy, livestock trade policy, transport, energy and telecommunications infrastructure project planning, and water management schemes.

Integrated policy assessment (IPA) is a type of modelling that is increasingly common in the environmental sciences and in environmental policy analysis; it integrates knowledge from two or more domains into a single framework, given that environmental problems do not respect the borders between academic disciplines. It recognizes that there are many ways to measure the impacts and outcomes of policy. While IPA models and approaches have developed significantly to become more realistic, much needs to be done in order to achieve better integration and to enhance their usefulness for making policy decisions. In fact, while these approaches, whether their goal is evaluation, optimization or identification of “tolerable windows”, offer alternative methods of analysis, they cannot be easily used in policymaking, because no simple predictive analysis can incorporate the impact of shifting social perspectives and values on the evolving social situation when communities, nations and the world face risks.<sup>64</sup> Policy assessment methods (see below) have largely evolved into applying economic methods with environmental and social impacts monetized to be included in assessment frameworks.

<sup>64</sup> Sharma and Norton, 2005.

#### 4.1.1. Cost-benefit analysis

Accurate valuation requires estimating the net results – benefits or costs – of actions to conserve or convert land uses, for example. Knowing the costs of biodiversity conservation in dryland areas, including opportunity costs, project costs and negative external impacts (wildlife impacts on cultivated areas, for example) is important. Cost-benefit analysis (CBA) is the policy assessment method in which TEV information is most commonly used.

CBA compares monetary costs and benefits of a particular action, project or policy – often versus the costs and benefits of the status quo – in matching terms and accounted for over time using discount rates (See Toolbox 6). This comparison is sometimes expressed as a cost-benefit ratio, with benefits as the numerator and costs as the denominator. Alternative options can then be ranked in accordance with their cost-benefit ratio.<sup>65</sup> This process determines the efficacy of a project or programme not only in terms of its direct monetary costs and benefits, but also considers its wider non-market environmental and social impacts (externalities) not taken into account in standard financial accounting analyses.

The underlying supposition of CBA is that what counts as a benefit or loss to one part of society does not necessarily count as a benefit or loss to the economy or society as a whole. The negative impacts (costs) of sometimes destructive wildlife species, for example hippopotamus or elephant, are concentrated on relatively few individuals living in close proximity (e.g. dryland farmers). Conversely, the benefits such as knowing that such animals exist, or taking a wildlife safari while on holiday, are shared by many around the world.

CBA requires that the economist ask if society as a whole will become better off by implementing the policy or project in question (e.g. protecting wildlife), rather than undertaking an alternative project or not implementing it at all. Essentially, a project or policy should be considered feasible only if it is capable of producing excess benefits such that everyone in society could be made better off.<sup>66</sup>

Whenever the final results of CBA are expressed in highly aggregated indicators, such as the aforementioned cost-benefit ratio, information is provided only on the effects of a change in total value. However, if the data gained during the valuation and subsequent CBA are presented in a suitably disaggregated and spatially explicit manner, much more can be inferred, for instance regarding the distribution of costs and benefits among social groups and income strata, or the equity implications for the “losers” from policy changes.

#### 4.1.2. Compliance cost analysis

Compliance cost analyses are focused on assessing the impacts that proposed regulation will have on industry, and their significance to the competitiveness of the sectors in question. They differ from CBA in that they focus on estimating the financial costs to different industrial or business sectors solely, rather than including indirect and non-use values or opportunity cost terms as CBA can.<sup>67</sup>

#### 4.1.3. Cost-effectiveness analysis

Cost-effectiveness analysis (CEA) comes closest to CBA, since it compares the different costs of attaining some objective. Different options that deliver the same objective are then compared and prioritized based on their cost-effectiveness-ratio. CEA, therefore, does not ask or attempt to answer the question of whether the goal of the policy

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<sup>65</sup> CBD Secretariat, 2007.

<sup>66</sup> This assumes no transaction costs. This outcome is referred to as a situation of potential Pareto improvement. If using CBA to assess the cost and benefits to society of a policy, it is necessary to choose a criterion for social efficiency. Allocative efficiency concerns reallocation of resources so as to achieve an increase in the net value of output produced by those resources. Pareto optimality is the welfare criterion which requires that an action which makes one person better off leaves nobody else worse off. For a project or policy to pass this test, compensation must be paid by the “winners” to the “losers” so that they are indifferent to the policy change. The potential compensation principle, integral to the Kaldor-Hicks test, differs from Pareto optimality in that a policy action is defined as efficient if those gaining from the change could compensate the losers, and still be better off; or if potential losers could compensate potential winners for not going ahead with the proposed change. In both cases once the potential exists for compensation to be transferred, the action is considered efficient regardless if the compensation is actually paid. The seminal reference on this topic is Freeman, 1993.

<sup>67</sup> Virani and Graham, 1998.

is justified, in the sense that the social benefits expected from this goal exceed the costs necessary to reach the goal, unlike CBA. In fact none of the options may be economically efficient, in the sense of monetary economic costs outweighing economic benefits.

CEA is appropriate whenever there are good reasons to believe that the benefits of meeting the objective outweigh the costs, and the priority given to meet the objective is therefore not under doubt. In other cases, however, CEA

### Toolbox 6: Choosing and calculating discount rates

A key assumption in economic theory underpinning investment in natural capital is that increased ecosystem protection or enhancement will improve the flow of benefits over time; and conversely, that degradation or a change in land use will disrupt ecosystem service delivery. Moreover, for impacts that extend over long periods, even intergenerationally, it is necessary to express biodiversity costs and benefits far in the future (for instance as a result of inaction on environmental policy fronts) in a manner which is comparable with those of today.

This means that economic analyses have a dynamic in changing asset bases supporting these services that should be captured. In order to be able to compare costs and benefits generated at different moments in time, all monetized values are discounted to a point “zero” in time and referred to as the net present value (NPV). An appropriate discount rate determines the change in value of a single unit of a cost or benefit for each year in the future – taking into account inflation, interest and other macroeconomic factors – compared to the value of the same unit today. With discounting, the benefits or costs of a particular policy programme can be assessed on a constant scale over a long period of time.

$$\text{Net Present Value} = \frac{(\text{Benefits}_1 - \text{Costs}_1)}{(1 + \text{Discount rate})^1} + \frac{(\text{Benefits}_2 - \text{Costs}_2)}{(1 + \text{Discount rate})^2} + \dots + \frac{(\text{Benefits}_n - \text{Costs}_n)}{(1 + \text{Discount rate})^n},$$

where subscripts indicate time periods and  $n$  is the life time of the project or policy.

Given that a change in asset value is equal to the difference between the value of future services before and after the change, there is still great uncertainty regarding how future services are to be valued or which discount rates to use. Selecting an appropriate discount rate is important because different rates produce very different results and affect policy recommendations accordingly. The higher the rate, the lower the rate of return attributed to future cash flows (for private goods) or social benefit (for public goods).

An **arbitrage** argument justifies using the rate of return of financial capital as the socially efficient discount rate because diverting investment capital into biodiversity conservation with an internal rate of social return below this level would be inefficient, i.e. lead to lower welfare outcomes.

Another method uses the **interest rate** as the discount rate on the basis that this rate is equal to the present value of future cash flows. Using this rate to convert all future costs and benefits into values, the project should be implemented only if its discounted NPV is positive.

The UK Government suggests that **Social Time Preference** – the value society attaches to present, as opposed to future, consumption – is the appropriate approach for discounting future benefits and costs. The Social Time Preference Rate (STPR) is based on comparisons of utility across different points in time or different generations.

Standard best practice implies using two or three justifiable discount rates in the analysis for comparison. It should be noted that assumptions of a constant scale are a limitation of the discount rate.

#### Resources:

HM Treasury, 2003. *The green book: Appraisal and evaluation in central government*. [pdf] Available at: <[http://www.hm-treasury.gov.uk/d/green\\_book\\_complete.pdf](http://www.hm-treasury.gov.uk/d/green_book_complete.pdf)>

Gollier, C., 2010. *Expected net present value, expected net future value, and the Ramsey rule*. [pdf] Available at: <[http://www.scor.com/images/stories/pdf/library/chairscor/chairscor\\_expectednetpresentvalue\\_062010\\_en.pdf](http://www.scor.com/images/stories/pdf/library/chairscor/chairscor_expectednetpresentvalue_062010_en.pdf)>

FAO, 1985. *Guidelines: Land evaluation for irrigated agriculture*. [pdf] Available at: <<http://www.fao.org/docrep/X5648E/x5648e0k.htm>>  
Cost-benefit knowledge bank for criminal justice. *Discounting*. [online] Available at: <<http://cbkb.org/toolkit/discounting/>>

may only be helping to select the least bad option among a list of (potentially) inefficient options. Even in those cases, CEA is sometimes used as a second-best option when a full-blown CBA would be desirable but many benefits cannot easily be monetized.<sup>68</sup>

## 4.2. MAINSTREAMING BIODIVERSITY IN NATIONAL ECONOMIC DEVELOPMENT PLANNING AND BUDGET PROCESSES

National development strategies are usually contained in National Development Plans (NDPs) and/or Poverty Reduction Strategy Papers (PRSPs), which form the primary development policy framework and medium-term planning tools in many countries. In many cases, the NDP/PRSP implementation mechanisms are tied to national budget processes through medium term fiscal frameworks (MTFFs) and medium term expenditure frameworks (MTEFs), which detail allocations of public expenditure over 3-5 year periods.

TEV results can demonstrate the value of investing in biodiversity in national development planning and budget allocation processes (see the WAVES example in Box 16). Moreover, understanding the development priorities identified as part of the national intensive, cross-sectoral dialogue that takes place on development planning is a crucial first step in identifying opportunities for mutually supportive (and cost-saving) solutions that will help build resilience in drylands land use, biodiversity conservation and economic policy – for instance better design of agricultural policy to take account of biodiversity benefits from pastoralism.

## 4.3. LEGAL AND POLICY-SELECTION APPLICATIONS

### 4.3.1. Liability and redress

In some countries, the legal framework for liability and redress priorities has been an important driver for the analysis and refinement of valuation methods. For instance, in the United States, the ability to use valuation information as the basis for legal redress has been a significant impetus for considering the value of damaged environmental resources. High damage costs, derived including through non-market valuation, have given plaintiffs a large incentive to demonstrate the monetary value of any damaged resources. As a result, valuation methods, and contingent valuation in particular, have come under considerable scrutiny in high-profile legal cases such as the *Exxon Valdez* oil spill, with guidelines having been developed for the appropriate use of stated preference techniques.<sup>69</sup>

In many other countries, however, weak legal systems, poorly defined and enforced property rights over damaged resources, and/or the fact that many damaged resources are governed by customary law or practices that are not necessarily recognized by legal systems in a national context, mean that (formal) legal drivers for the application of valuation tools are currently weak to non-existent.<sup>70</sup>

### 4.3.2. Evaluating potential new instruments

Identifying a set of potential interventions for improved management of dryland biodiversity requires an understanding of the drivers of biodiversity loss in these regions, and of measures that could combat these drivers. Valuation information, and the results of policy assessment procedures, can contribute to evaluating proposed policy instruments against the following criteria:

- **Effectiveness:** Will the intervention achieve the biodiversity conservation goal?
- **Economic (static) efficiency:** Will the intervention deliver on the set biodiversity target at lowest cost?
- **Economic (dynamic) efficiency:** What role can the intervention play in providing continued incentives to innovate or improve performance and reduce costs further over time?

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68 CBD Secretariat, 2007.

69 CBD Secretariat, 2007.

70 CBD Secretariat, 2007.

- **Administrative feasibility and transactions costs:** Is the intervention administratively feasible, and at what cost?
- **Political viability:** Will the intervention achieve public and political support?
- **Equity:** What stakeholders are impacted by the intervention and how are they impacted? Does the intervention help address perceived “unfairness” in how natural capital resources are allocated? (e.g. marginalization of pastoral communities in some cases?)

### **Box 16:** Overview: Wealth Accounting and the Valuation of Ecosystem Services (WAVES): A Global Partnership Program

**Program Goal:** To promote sustainable development worldwide through the implementation of comprehensive wealth accounting that focuses on the value of natural capital and integration of “green accounting” in more conventional development planning analysis.

#### **Specific Objectives:**

1. Implement ecosystem accounting at the national or sub-national level in several developing and developed countries;
2. Incorporate natural capital accounting in policy analysis and development planning;
3. Develop standardized guidelines for the implementation of ecosystem accounting that can be implemented globally;
4. Promote adoption of ecosystem and natural capital accounting beyond the WAVES’ partner countries.

#### **Program Activities:**

##### *Objective 1*

1. Construct ecosystem and comprehensive wealth accounts;
2. Establish an institutional structure in each country to guide ecosystem accounting;
3. Build support capacity for ecosystem accounting in partner countries.

##### *Objective 2*

1. Identify potential policy applications for natural capital accounting and incorporate accounts into country policy applications;
2. Build support and local capacity for analysis in partner countries.

##### *Objective 3*

1. Establish a technical experts group to guide development and implementation of methodologies for ecosystem accounting and ensure cohesion, consistency and scalability among the country studies;
2. Contribute guidelines for ecosystem accounting to the revised Handbook for the System of Environmental and Economic Accounting.

##### *Objective 4*

1. Establish a broad platform in the Global Partnership for sharing experiences, communicating and disseminating results, and conducting outreach to other countries and organizations;
2. Participate in international forums that promote national accounting, such as the UNEP’s Green Economy Initiative;
3. Conduct a review of developed and developing country experiences with environmental accounting to understand the obstacles to and opportunities for promoting environmental accounting.

*Source: Wealth accounting and the valuation of ecosystem services (WAVES): A global partnership. Sixth meeting of the UN Committee of Experts on Environmental-Economic Accounting. New York, 15-17 June, 2011. ESA/STAT/AC.238 UNCEEA/6/7. [pdf] Available at: <<http://unstats.un.org/unsd/envaccounting/ceea/meetings/UNCEEA-6-7.pdf>>*

#### 4.4. SUSTAINABLE FINANCING SCHEMES

##### *National programmes for biodiversity conservation in drylands*

Partnership funding for development, as channelled through national budgets, is potentially one of the largest sources of sustainable funding, but *only* if links are made between biodiversity and national development goals.

National budgetary cycles operate in the context of changing modalities for development aid in many developing countries, including countries important for drylands biodiversity conservation. Country-specific aid delivery frameworks have been evolving away from development assistance that is project-driven and donor-managed<sup>71</sup> and towards the new framework of budget support, defined as “*a method of financing a partner country’s budget through a transfer of resources from an external financing agency to the partner government’s national treasury. The funds thus transferred are managed in accordance with the recipient’s budgetary procedures.*”<sup>72</sup>

In this new modality, development aid funds are channelled directly through the budgets of partner countries, and spending decisions are based on a nationally developed strategy defining the national development priorities. Understanding the development priorities identified as part of the intensive, cross-sectoral national dialogue that takes place on development planning is a first step to securing national and external funding.

This process is, in effect, an extension of the process of mainstreaming biodiversity into national development planning. Budget making is an iterative process involving several back-and-forth exchanges between central budget committees and line ministries during both preparation and execution phases. This is, in reality, a political process in which ministries must make a strong, substantiated case linked to development priorities in order to receive funding.<sup>73</sup> This typically is strengthened by sound economic arguments underpinned by the type of information that valuation studies generate.

##### *Payments for ecosystem services schemes*

Given the global nature of the benefits of dryland conservation efforts, the value of biodiversity (even if distant seeming) could be better reflected in the prices paid by those who benefit and used to compensate those who bear the additional costs of providing them.<sup>74</sup> For instance, the value of wildlife does not always translate into funding for conservation activities; there is a real cost to the countries which pay for the upkeep of wildlife populations – a cost that may not always be offset by tourism revenues and complementary livestock production.<sup>75</sup> Payments for ecosystem services (PES) schemes may be helpful in this regard.

##### *Resource mobilization in MEA implementation*

International funding sources are often time-limited and project-focused, rather than continuous and targeted to support programmatic delivery of public services. For this reason, many consider national sources and private sources of finances to be central to securing sustainable, secure resource flows to ensure progress on biodiversity conservation targets.

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71 For more information on the change from project to budget support, see Overseas Development Institute, 2006, p. 10; Bird, 2007; Booth and Fritz, 2008.

72 OECD/DAC, cited in Lawson and Bird, 2008, p. 23.

73 Individuals, institutions and organizations engaged in lobbying activities in general seek to persuade decision-makers of why certain issues, policies or laws should be supported or rejected. Lobbying in order to influence political decisions is recognized as a legitimate and necessary part of the democratic process, despite some negative connotations associated with the practice. The same is true of internal lobbying as part of national budgetary processes.

74 Mearns, 1996.

75 Norton-Griffiths and Said, 2009.

#### 4.5. BIODIVERSITY-RELATED ENTERPRISE DEVELOPMENT

Value chain analysis or supply chain analysis aspects of a valuation exercise may point the way towards interesting policy solutions indirectly supporting biodiversity conservation, i.e. business development, value chain management, and niche market development based on biodiversity values (see Box 17 for an example).

**Box 17: Case study synopsis: Adding value to livestock diversity: Marketing to promote local breeds and improve livelihoods**

**Background:** Throughout the world and over centuries, small-scale livestock keepers and pastoralists have developed animal breeds that are well suited to their local conditions. However, these breeds are in danger of disappearing, pushed out by modern production techniques and out-competed by exotic breeds. Finding niche markets for their products is one possible way of ensuring the survival of these breeds.

**Methodology:** This book describes eight cases from Africa, Asia and Latin America where outside interventions have attempted to develop markets for specialty products from local breeds. The countries represented are Argentina, India, Kyrgyzstan, Mauritania, Mongolia, Somalia and South Africa.

**Findings:** (1) These cases show some of the promise and pitfalls of niche marketing of products from local breeds. On the one hand, niche markets may be vital for the survival of many local breeds, which cannot compete with higher-producing exotic breeds in mass markets. On the other hand, many local breeds may be ideally suited for niche markets: they have unique characteristics that may be undesirable on the mass market but are ideal for certain market segments. (2) Among the cases studied, the most common approaches to exploiting a niche market involved finding new markets, either for an existing product or for an entirely new product. Less common were approaches involving existing markets, either for an existing product or for a new product. (3) The niche marketing interventions included four types of activities: improving animal production, processing, organizing, and building a value chain. Of these, improving animal production was least common.

**Recommendations:**

- |  |   |
|--|---|
| (1) Use existing resources;                        | (7) Focus on quality;                       |
| (2) Identify a suitable entry point;               | (8) Build capacity;                         |
| (3) Start small;                                   | (9) Don't depend too much on outsiders;     |
| (4) Do the research;                               | (10) Ensure long-term demand;               |
| (5) Identify special characteristics of the breed; | (11) Don't put all your eggs in one basket. |
| (6) Find a viable business model;                  |   |

**Conclusions:** Niche marketing can provide opportunities for sustainable production in marginal areas and can improve the livelihoods of livestock keepers and people involved in the processing and trade of products. It may especially benefit women and the poor. It can also be a tool for conserving breeds. Efforts to promote niche marketing may help local people connect to markets for the first time, giving them skills that they can use in exploring other markets and developing other enterprises. Niche markets may allow actors early in the value chain – livestock keepers and small-scale processors – to capture a greater share of the end-value than in a mass market. This will make it attractive for these actors to continue and expand their businesses. Niche marketing is by nature relatively small-scale. For large numbers of producers, it cannot replace the need to produce products for a wider, mass market. But for local breeds, it may be possible to find a match between the qualities of the breed, the features of a particular product, and the demands of a specific market. Making this match will help conserve the breed as well as provide a livelihood for people involved in the value chain.

*Source: Text taken from LPP, LIFE Network, IUCN–WISP and FAO, 2010. Adding value to livestock diversity – Marketing to promote local breeds and improve livelihoods. FAO Animal Production and Health Paper No. 168. Rome: Food and Agriculture Organization of the United Nations.*

## 5. CONCLUSION

One of the more interesting perspectives emerging from the recent literature on biodiversity and drylands is the recognition that dryland ecosystems are the result of centuries of human-animal-environment interaction (largely by pastoral groups). However, the description of the drylands as “pastoral ecosystems”, and the focus on productive systems, livelihoods and poverty reduction, signals a change.

The economic literature reviewed in this study demonstrates that much of the value of drylands biodiversity is derived from “use” – direct and indirect – and the “societal value” of biodiversity is a function of these uses, from local to global. It is essential that practitioners and policymakers start and indeed continue to identify ways to make the sustainable use of drylands biodiversity beneficial both economically and ecologically. While valuing biodiversity may be a complex procedure, a focus on the ecosystem services provided by drylands ecosystems and biodiversity, and a better understanding of their economic value, can contribute substantially to such work. Furthermore, by involving all relevant stakeholders right from the start in valuation processes (as in for example the TEEB tiered approach and the OSLO six-step approach, Box 8. Overview of OSLO’s six-step assessment model<sup>18</sup>), and particularly those stakeholders who may be more directly affected at the local level, would ensure higher success rates of achieving sustainable land management objectives in such areas.

Pastoralism may already provide an answer to this in part. Many people in the drylands pursue livelihoods that conserve biological diversity in innovative ways; but well-managed pastoralism has the possibility of making a difference for many more. Drylands agriculture, following sustainable land management practices, can also contribute to positive socioeconomic and biodiversity outcomes. Dryland forests valuation information show the important role these ecosystems play at local levels, both in terms of subsistent production/consumption, and harvesting as a supplementary livelihood strategy. Because they are economically or culturally valuable, the probability is that, given the opportunity, dryland ecosystems will be conserved informally by communities living in the area – and off that land. Many traditional land management practices have proven to be more economically viable than “modern” alternatives, and simultaneously provide conservation benefits for this same reason.

Where market failures occur, however, opportunities arise to revisit policies and see what needs to or can be adjusted. The literature shows how land-use comparisons favour intensive agriculture practices, urban expansion, lack of investment in degraded land, etc. in many cases because the opportunity costs – the lost biodiversity and other uses – are undervalued. This points to the crucial role of valuation.

More productive, sustainable drylands, with wealthier, healthier populations, contribute not only to well-being in these regions but also to well-being at the national level, e.g. through tax contributions, and the achievement of national development goals and internationally agreed targets and standards on poverty alleviation and environmental quality. Indeed, the responsible use of biodiversity in drylands (and sustainably managed drylands in general) can play a key role in relation to the achievement of international goals such as zero net land degradation and the transition to a green economy.

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## **ANNEX 1. LITERATURE SURVEY METHODOLOGY**

### **1.1. CALL FOR INFORMATION**

As a first step towards gathering input and literature from stakeholders with expertise on “the value of biodiversity in dry and sub-humid lands”, the authors assembled a list of 71 contacts provided by colleagues from the Global Mechanism and from the study team’s own networks. A “call for literature” email was sent to this list of contacts between 25 October and 9 November 2012. 43 individuals responded to the call for literature, each providing one or more of (1) references to literature relevant to the study topic; (2) suggestions for search terms; and (3) recommendations for additional people to contact.

### **1.2. LITERATURE SEARCH**

An initial list of search terms in English was developed based on a detailed scan of CBD technical series reports 4, 27 and 28. Additional search terms were added to this list based on inputs from the network of experts. The final list of search terms included terms across four categories: valuation, methodology, location/zone/land cover, and regions/countries. The search terms were applied systematically using the United Nations library system, the Environmental Valuation Reference Inventory (EVRI) database, ASEAN Centre for Biodiversity database and Google Scholar to identify literature that incorporated one term from each of these categories in a significant way. A shorter list of key search terms derived from the longer list was translated into French and Spanish and applied using Google Scholar and the United Nations Office at Geneva (UNOG) library. Elena Kreuzburg<sup>76</sup> also contributed search support using Russian-language sources.

### **1.3. SEARCH RETURNS**

The literature search identified 98 studies of direct relevance to economic valuation of biodiversity in dryland and sub-humid regions, plus 138 items with some information to framing considerations on valuing biodiversity in dryland and sub-humid regions, including geographic location. Not all studies were valuation studies per se, but may have included secondary sources of valuation literature.

### **1.4. ANALYSIS FRAMEWORK**

In reviewing the literature uncovered by survey, the key dimensions used to analyse the studies were:

- Institutional stakeholders;
- Study objectives and relevancy as assessed by 1) climate descriptor (arid, semi-arid, sub-humid, dryland), 2) primary or secondary economic valuation study and 3) biodiversity and/or ecosystem services or economic sector related to biodiversity or ecosystem services;
- Region, national jurisdiction;
- Valuation approach, with a view to assessing study quality;
- Key valuation results; and
- Policy relevancy and application.

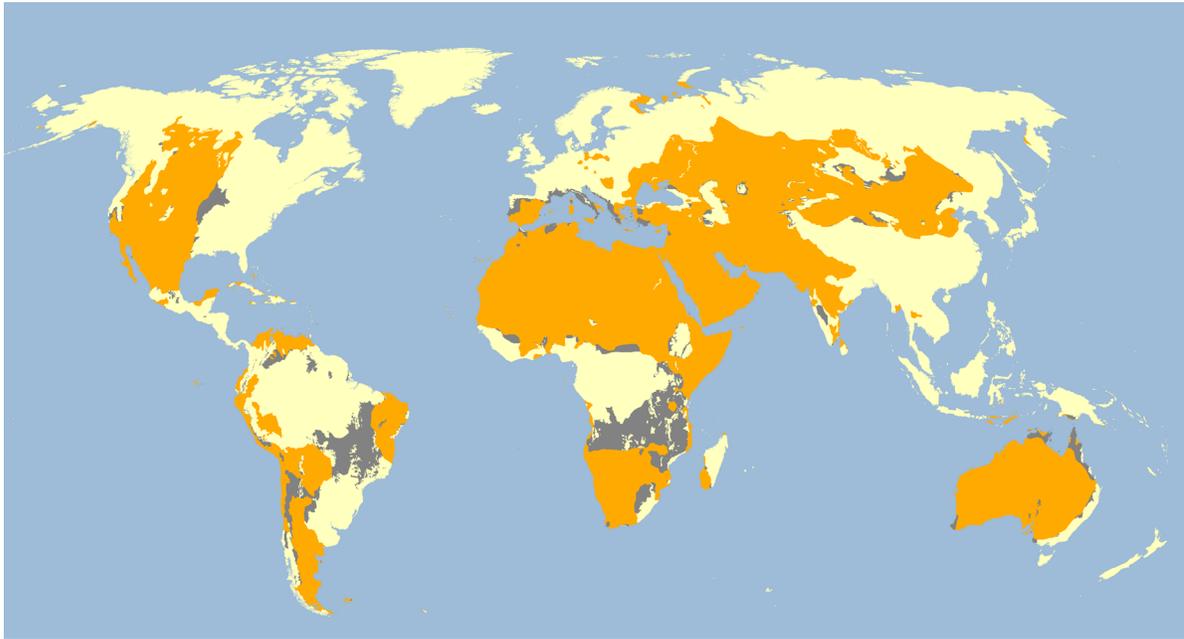
<sup>76</sup> Ph.D. Biology (Russian Academy of Science); M.Sc. in Landscape Ecology (in progress); B.A. General Science (Biology).

### **1.5. LIMITATIONS OF THIS STUDY**

A further number of studies were identified at an advanced stage in this study. Due to time constraints, these resources were not included in the review but they have been included in the bibliography for the interest and convenience of practitioners.

## ANNEX 2. MAPS SHOWING GEOGRAPHIC SCOPES OF THE CBD PROGRAMME OF WORK ON DRY AND SUB-HUMID LANDS AND UNCCD RESPECTIVELY

**Figure A.1:** Map of revised delineation (decision X/35) of CBD programme of work on dry and sub-humid lands



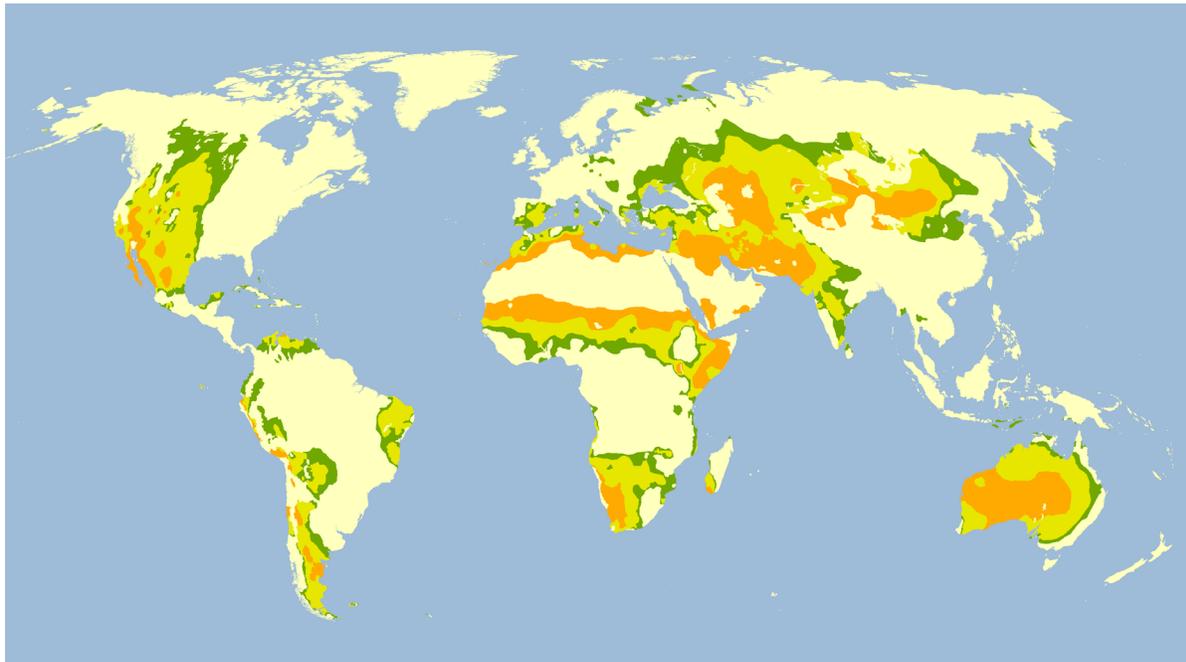
**Delineation of areas in relation to the CBD PoW on Dry and Subhumid Lands**

- included by definition,  $P/PET < 0.65$
- presumed included: dryland features, but  $P/PET \geq 0.65$



Source: ESRI, 1993; UNEP/GRID, 1991  
CRU/UEA; WWF-US, 2004  
Scale: 1:100 million  
Projection: Robinson  
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**Figure A.2:** Map of UNCCD delineation of global drylands; excludes hyper-arid zones



**UNCCD delineation of drylands**

- dry subhumid: P/PET 0.50 - 0.65
- semiarid: P/PET 0.20 - 0.50
- arid: P/PET 0.05 - 0.20



Source: ESRI, 1993; CRU/UEA; UNEP/GRID, 1991  
Scale: 1:100 million  
Projection: Robinson

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