ENVIRONMENTAL COMPLIANCE FACTSHEET:
Ecosystem Services in Environmental Impact Assessment


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PURPOSE

This factsheet provides information on ecosystem services (ES) as well as best practices to incorporate consideration of ecosystem services into USAID's environmental impact assessment (EIA) process and environmental compliance procedures. The factsheet has three goals. First, it aims to describe the fundamental principles of an ecosystem services framework. Second, it aims to explain how to apply this framework when performing an ecosystem service valuation (ESV). Third, it aims to suggest how to usefully incorporate ecosystem services into USAID's environmental compliance procedures, as stated in 22 CFR 216 Agency Environmental Procedures ("Reg 216").

Consideration of ecosystem services allows for a comprehensive assessment of a project's environmental and social impacts. Performing an ESV is a best practice for the environmental impact assessment (EIA) process. It can inform Initial Environmental Examinations (IEE) as well as more detailed assessments like Environmental Assessments (EA), Environmental Impact Statements (EIS) or Programmatic Environmental Assessments (PEA). By considering ecosystem services, USAID staff can develop a more accurate assessment of environmental risks as well as how to mitigate those risks with specific management or development decisions. Project design teams, program officers, technical staff management staff, and other partners can use this document to incorporate ecosystem services into environmental compliance procedures.

INTRODUCTION

The EIA process often treats environmental and social impacts separately, however, applying an ecosystem services approach explicitly links environmental impacts to social impacts. Ecosystem services sustain our economies and our well-being. While these services are largely provided for no cost, they deliver necessities like clean water, breathable air, nourishing food and climate stability. By valuing ecosystem services, USAID and implementing partners (IPs) can make decisions that may strengthen both a project's performance and community resilience.

Valuation of ecosystem services may enhance the environmental impact assessment (EIA) process by providing decisionmakers with a framework for analyzing the potential effects of a proposed action. Systematically incorporating ecosystem services into the EIA process will help USAID and IPs understand how a project may impact priority ecosystem services, as well as how the project's performance or success may depend on certain ecosystem services. By better understanding project impacts and dependence, USAID and IPs can better manage project risks – both the environmental and social consequences of projects – while also supporting USAID's stated environmental policy and development goals.

This factsheet describes a basic framework for performing ESVs that can be applied to a range of USAID projects and activities throughout the EIA process. An ESV is a framework that quantifies and values, in monetary, biophysical or other ways, an ecosystem and/or its ecosystem services. The framework has accounted for the fact that USAID may lack resources to develop primary data to characterize ecosystem services at the local level. The framework therefore suggests cost-effective and practical ways to evaluate ecosystem services in data-poor or resource-poor contexts.

Box 1: USAID's Environmental Procedures This factsheet assumes basic knowledge of USAID's environmental procedures (22 CFR 216 and associated directives). For more information about USAID's environmental procedures, see the Global Environmental Management Support website.

DEFINING NATURAL CAPITAL AND ECOSYSTEM SERVICES

Capital comes in many forms: built, financial, human, social and natural. All forms of capital work together to create economies. Natural capital lies as the foundation of all others. It generates the goods and services known as ecosystem services, or the many benefits – large and small, direct and indirect – that ecosystems provide to people and USAID development objectives (Landsberg et al. 2013).

Ecosystem services include tangible economic goods, such as food and timber, along with benefits that are not as easy to quantify, such as flood protection or nutrient cycling. Ecosystems offer many overlapping benefits. For example, wetlands not only improve water quality, they also reduce flood risk while providing wildlife habitat. Forests not only provide wood, food, and non-timber products, but they also sequester carbon, prevent erosion, support pollination, filter water and act as spaces for recreation or cultural significance.

Ecosystems serve different beneficiaries at different geographic and temporal scales. At the local level, ecosystem services often sustain rural livelihoods and subsistence, particularly for the poor. Fishing local waters, for example, provides both income and food for millions of low-income families. Regionally, communities and businesses benefit from water stored, filtered and delivered by a forested watershed. Globally, ecosystems regulate climate. Ecosystems also work over varying time scales, from the annual production of crops to the long cycles of soil formation (Landsberg et al, 2011).

Box 2: Definitions

Natural Capital - The naturally occurring assets such as wetlands, forests and coral reefs.

Ecosystem - A dynamic complex of plant, animal and microorganism communities and their non-living environment interacting as a functional unit (Convention on Biological Diversity).

Ecosystem Function - The capacity of natural processes and components to provide goods and services that satisfy human needs, either directly or indirectly (de Groot et al. 2002).

Goods and Services - The many benefits (such as water supply, carbon sequestration and flood risk reduction) that ecosystems provide to people, projects and activities.

The relationship among natural capital, ecosystem function and ecosystem goods and services is illustrated via the role of a forest and a watershed in water capture and storage, which results in a reduced flood risk in Figure 1.

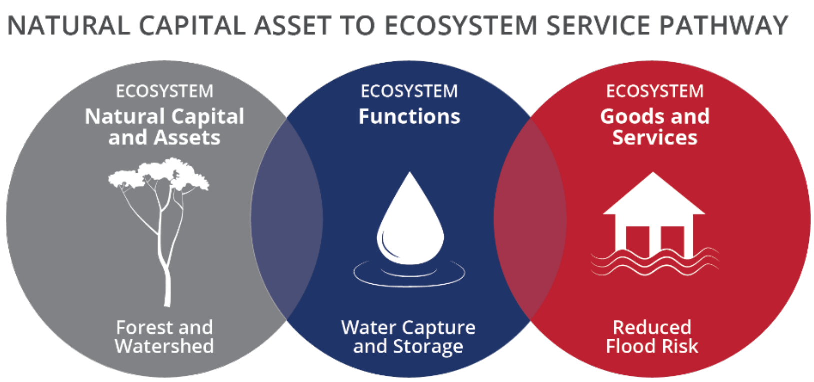

Figure 1. Visual of the pathway from a natural capital asset to an ecosystem service. (Source: Earth Economics 2018).

Ecosystem services support all dimensions of human well-being – economic stability, physical and mental health, and cultural heritage (Figure 2).

ECOSYSTEM SERVICES PROVIDED BY DIFFERENT ECOSYSTEM TYPES

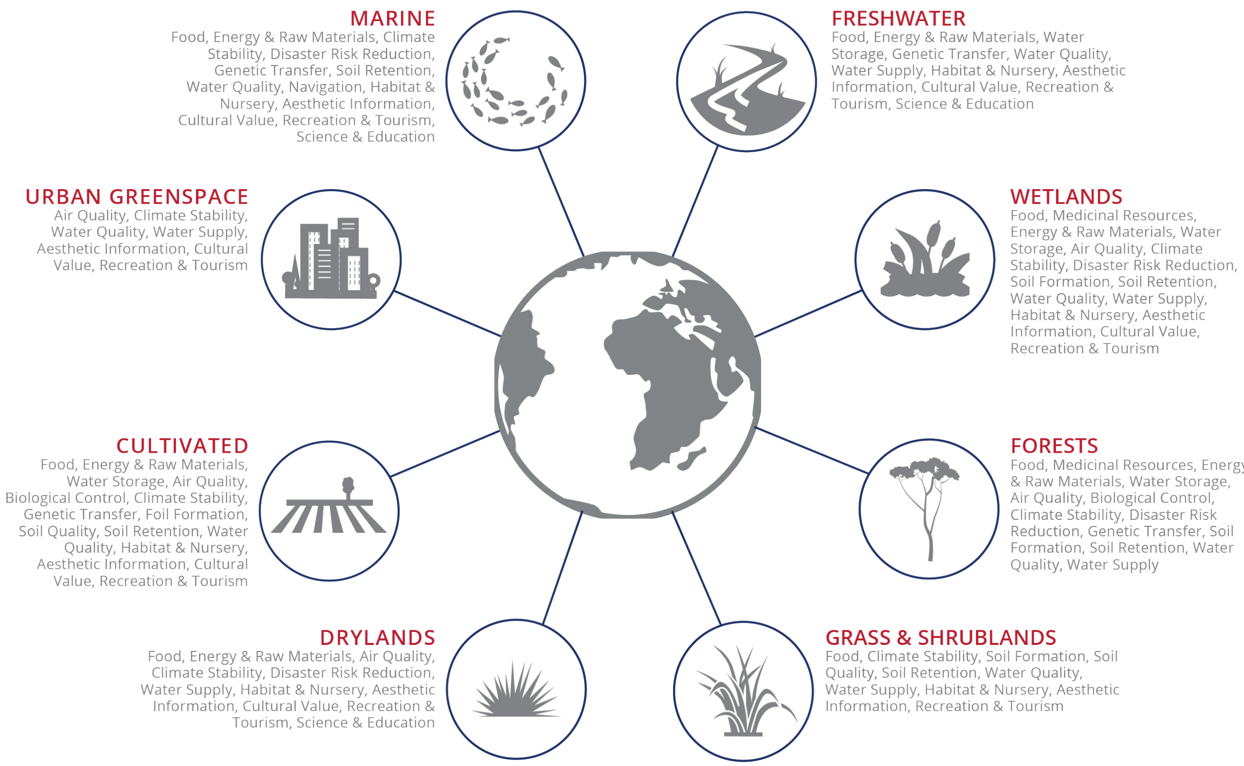

Figure 2. Graphic of common ecosystem services provided by different ecosystem types. (Source: Earth Economics 2018).

WHY VALUE ECOSYSTEM SERVICES AS PART OF THE EIA PROCESS?

Because ecosystem services support processes that sustain life and human well-being, it is important to consider how USAID projects and activities will affect these services. While USAID does not have a specific requirement for considering ecosystem services, international financial and development organizations are increasingly incorporating ecosystem services into their practice standards. For example, the International Finance Corporation considers ecosystem services in environmental and social impact assessment as part of their Performance Standards on Environmental and Social Sustainability (IFC, 2012). Integrating ecosystem services into the EIA process will strengthen both the EIA process and USAID's stated environmental policy goals.

When communities make investments to protect, support and restore ecosystem services, communities become both more stable and more resilient. Improving ecosystem services can safeguard living conditions and buffer environmental impacts on health and food security. For example, preserving wetlands will buffer communities against the impacts of floods and storms while also providing wildlife habitat. Restoring degraded forests can improve water storage and supply while also improving nearby crop production (Ding et al, 2017).

Valuing ecosystem services allows them to be considered at crucial points in the EIA process – during project design, during the screening phase (IEE development), as part of a more detailed environmental assessment and/or as part of the mitigation plan. Systematically considering ecosystem services throughout a project's development may help reduce problems in the EIA process, such as poor scoping, insufficient engagement of stakeholders, incomplete identification of impacts and mitigation proposals not commensurate with the importance of impacts (Rosa and Sanchez, 2014). Consideration of ecosystem services will also strengthen USAID's environmental policy goals. As stated in 22 CFR 216 Agency Environmental Procedures, these goals are to:

- Ensure that USAID and the host country identify and consider the environmental consequences of USAID-financed activities prior to a final decision to proceed and that USAID adopts appropriate environmental safeguards.
- Assist developing countries to strengthen their capabilities to acknowledge and effectively evaluate the potential environmental effects of proposed development strategies and projects, and to select, implement and manage effective environmental programs;
- Identify impacts resulting from USAID actions upon the environment, including those aspects of the biosphere that are the common and cultural heritage of all mankind; and
- Define environmental limiting factors that constrain development and identify and carry out activities that assist in restoring the renewable resource base on which sustained development depends.

Box 3: A Note About Biodiversity

Biodiversity and ecosystem services are sometimes treated as interchangeable concepts. Though intimately related, they are not synonyms. Biodiversity refers to the variety and variability of ecosystems, species, genes and habitats in the world. Ecosystem services are the benefits that this variability produces.

Biodiversity therefore both underpins and cuts across ecosystem services. It plays an integral role in determining the quantity, quality and reliability of those services. Depending on one's view, biodiversity can be a regulator of fundamental ecosystem processes, a final ecosystem service itself, or a good (Mace et al, 2012).

Conservation of biodiversity is also required for USAID under Foreign Assistance Act Sections 117, 118 and 119. See USAID's Biodiversity Policy.

Incorporating concepts of ecosystem services into USAID EIA process will help USAID and IPs understand and manage the environmental and social consequences of projects and activities, as well as enhance project outcomes and community resilience. Understanding how programming depends upon and impacts ecosystem services will inform decisions that not only minimize and mitigate harmful effects, but also could sustain or improve natural capital and human well-being (Landsberg, 2013).

ECOSYSTEM SERVICES CLASSIFICATIONS AND FRAMEWORKS

Ecosystem services have been globally acknowledged to play a crucial role in economic, environmental and social well-being – the three pillars of sustainable development (UNDESA, 2015).

Box 4: Many Ecosystem Services Frameworks Exist

Although the MEA is the most-cited framework, several others exist. These include The Economics of Ecosystems and Biodiversity (TEEB) framework and the Common International Classification of Ecosystem Services (CICES), among others. For more information on frameworks, see Annex 1.

Consistent with the Millennium Ecosystem Assessment (2005) framework, the USAID Biodiversity Policy (2014) names four categories of ecosystem goods and services. They include: 1) provisioning goods or services, or the production of basic goods such as food, water, fish, fuels, timber, and fiber; 2) regulating services, such as flood protection, purification of air and water, waste absorption, disease control and climate regulation; 3) cultural services that provide spiritual, aesthetic and recreational benefits; and 4) supporting services necessary for the production of all other ecosystem services, such as soil formation, production of oxygen, crop pollination, carbon sequestration, photosynthesis and nutrient cycling.

APPLYING AN ECOSYSTEM SERVICES FRAMEWORK TO THE EIA PROCESS

Despite general agreement about how to categorize ecosystem services, no such global agreement exists regarding how to value these services in practice. The Intergovernmental Science Policy Platform on Biodiversity and Ecosystem Services (IPBES) – an organization founded under the United Nations "to strengthen the science-policy interface for biodiversity and ecosystem services for the conservation and sustainable use of biodiversity, long-term human well-being and sustainable development" – states that different valuation methodologies are appropriate for different policy or decision-making contexts (IPBES, 2016).

Although applying the right ESV method depends on context, common best practices exist. Below we describe best practices for applying ESVs to the EIA process. These best practices can strengthen the EIA process throughout every project stage (Scoping, Impact Analysis, and Planning). The best practices described are synthesized from other guidelines – namely the World Resources Institute's *Weaving Ecosystem Services into Impact Assessment: A Step by Step Method* and supporting documents.

USAID engages in a wide range of project types and locations and many projects occur in contexts of limited financial and/or technical resources. Therefore, the type of valuation performed will need to be adapted to the project context.

Box 5: One Successful Application of ESV in the EIA Process

In southern Guinea, the Simandou iron mine and railway port were built in 2012. Managed by the Rio Tinto Group, the project involved two open pits, a 670-km railway, and a deep-water port. The project affected agricultural land, forests, mangroves, grasslands and a large aquatic ecosystem. This project described and identified potentially affected ecosystem services and assessed the impacts on those services. For example, the project considered how ecosystems play a role in providing food, water, shelter, and cultural value. The SEIA discussed how the project will try to enhance these benefits while also mitigating adverse impacts (Simandou SEIA, 2012). Because a number of these impacts were not ones typically identified as part of a traditional EIA incorporating ecosystem services improved this project's impact analysis. The project's ESIA proposed specific mitigation or compensation measures for each impacted ecosystem service as part of a larger mitigation plan (Rosa and Sanchez, 2014).

BEST PRACTICES FOR APPLYING ESVS TO THE EIA PROCESS

Application of ESVs is an integral part of the EIA process; within USAID's environmental compliance process, there are numerous stages where ESV may be included. At the scoping level, the goal is to identify the range of ecosystem services that the project may depend upon or that the project may impact, while the impact analysis phase of an EA would warrant a more detailed analysis of the specific ecosystem services that could be either impacted by the project or that the project may depend upon for its long-term success. Figure 3 illustrates the various entry points for ESV within USAID's EIA process.

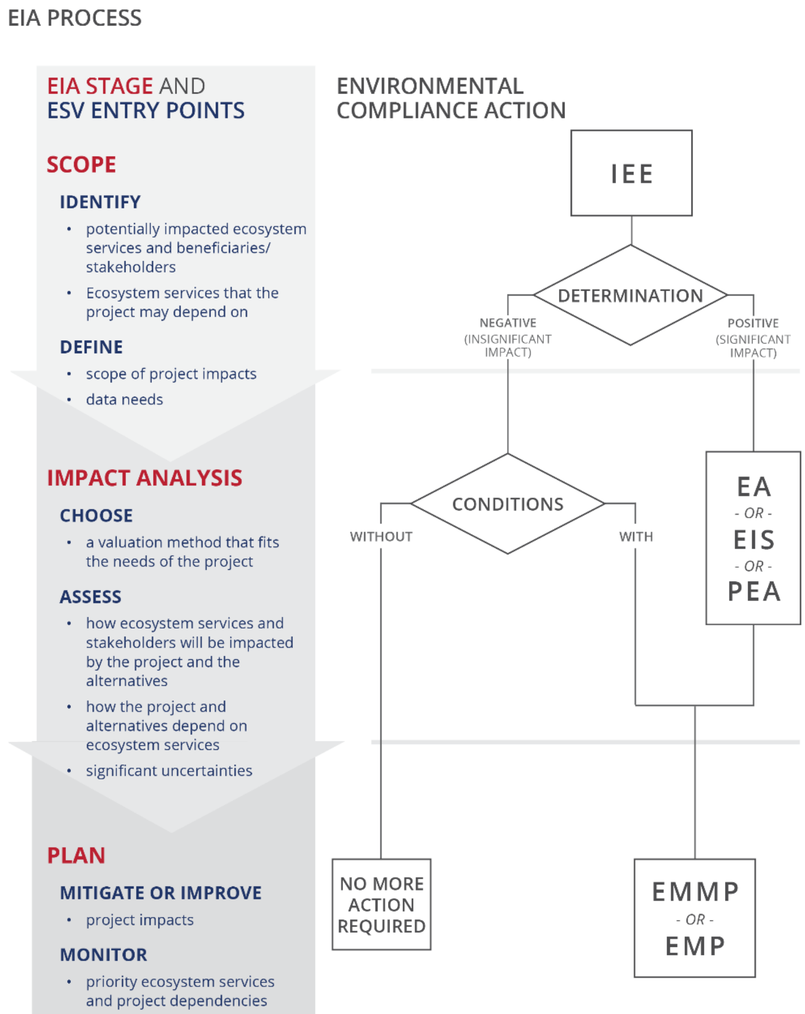

Figure 3. Flow-chart of the EIA process including applicable ESV best practices. (Source: Earth Economics 2018).

STAGE I: SCOPE – IDENTIFY AND DEFINE

The scoping stage of the EIA process typically involves a screening, or preliminary review for potentially significant impacts, also known as the Initial Environmental Examination (IEE). Incorporating an ESV at this stage identifies the stakeholders, ecosystem services and project dependencies and impacts to be addressed in further stages of the process (Landsberg, 2011). It can inform the IEE and the Threshold Decision that determines if a project requires a more comprehensive environmental assessment. The following are best practices for performing an ESV that will complement the scoping stage of the EIA process:

- Identify potentially impacted ecosystem services and beneficiaries/stakeholders
- Identify ecosystem services and other conditions that the project may depend upon
- Define the scope of project impacts
- Define data needs

IDENTIFY POTENTIALLY IMPACTED ECOSYSTEM SERVICES AND BENEFICIARIES/STAKEHOLDERS

By definition, an ESV identifies those ecosystem services and beneficiaries that a project may impact. The process of identifying those ecosystem services and beneficiaries can be performed in many ways depending on the resources, research and time required. USAID and IPs can use qualitative and quantitative field assessments, secondary data like land cover maps or state-of-the-environment reports, and/or ecosystem service mapping and decision-support tools. See Annex 1 for a list of available mapping, data collection and decision-support tools.

Stakeholder input also reveals people's dependence on ecosystem services. By engaging stakeholders, USAID and IPs can establish baseline data for priority ecosystem services, or current levels of ecosystem use and benefit. As part of the scoping stage, an ESV can reveal stakeholders and environmental impacts that may otherwise be overlooked. An ESV also helps to prioritize the ecosystem services need to be addressed in further stages of the EIA.

Box 6: Applying Ecosystem Services to the IEE

In Malawi, an Initial Environmental Examination (IEE) considered the potential environmental impacts related to the construction of secondary schools in about 200 rural sites around the country. Although the IEE didn't explicitly apply an ecosystems services framework, it did consider potential adverse impacts to ecosystem goods and services. For example, it considered the impact of construction practices on the supply of goods such as timber and sand, as well as on ecosystem services like flood control, recreational values, water supply and quality. It also considered how climate change will likely decrease ecosystem services by affecting access to clean water, altering animal distributions and health, and impacting biodiversity hotspots, such as wetlands. By considering such impacts, the IEE made logical suggestions about how to mitigate and compensate for them. For example, to address supply issues and associated impacts, the IEE suggested sourcing sand and timber only from government-sanctioned sources. To address construction impacts on vegetation, the IEE suggested planting two saplings for every tree removed (USAID, 2011).

IDENTIFY THE ECOSYSTEM SERVICES THE PROJECT MAY DEPEND ON

Because some ecosystem services are increasingly scarce, USAID and IPs also need to consider a project's dependence on ecosystem services. Gaining baseline information about project dependence on ecosystem services can uncover operational risks and opportunities. Identifying these risks and opportunities can improve project design at a stage when it is still malleable (Landsberg et al, 2011). An ESV also helps to prioritize project dependencies that need to be addressed in further stages of the EIA process.

DEFINE THE SCOPE OR SCALE OF THE PROJECT'S IMPACTS

Ecosystem services are produced and consumed differently at local, regional and global scales. For example, carbon gets sequestered locally (within a particular farm or forest), but the benefit of climate stability accrues globally. Assessments of ecosystem services require geographical boundaries that fit the needs of the project or impacted community. Boundaries should align as closely as possible with the scale of the impacted region.

Project impacts also change depending on time scale. USAID and IPs need to consider the type of impact appropriate during the EIA process. Projects have direct, indirect and cumulative impacts, all of which can occur over distinct timeframes. As a result, impacts on ecosystem services may also vary in time and space. Performing an ESV can help to reveal or recognize impacts – especially indirect and cumulative ones – that may otherwise be missed during the EIA process.

Box 7: Defining Different Types of Project Impacts

Direct impacts – Impacts on the environment that are caused by the action and occur in the same time and place (40 CFR 1508.8). For example, converting a wetland into agricultural land directly impacts the local environment.

Indirect Impacts - Impacts on the environment, which are not a direct result of the project, often produced away from or because of a complex pathway. For example, a development could change the water table, which could cause an impact on the ecology of a nearby wetland.

Cumulative Impacts - Impacts that result from incremental changes caused by other past, present or reasonably foreseeable actions together with the project. For example, within a watershed, combined reductions in flow volumes may result from irrigation, municipal and industrial water withdrawals.

DEFINE DATA NEEDS

The decision about whether to gather new data in any project location depends on factors such as time, funding, technical capacity, the availability of transferrable data and whether new data is needed to gauge a project's impact or decide on project design.

Data-scarce regions present a common valuation problem. The accuracy of any valuation suffers without site-specific data on ecosystem services. One way to circumvent this problem is to use a benefit transfer method (BTM). Broadly defined, benefit transfer means "the use of existing data or information in settings other than for what it was originally collected" (Rosenberger, 2003). In BTM, values from primary studies on ecosystems and communities similar to the study site are used in lieu of site-specific data for area in question. This method can serve as an efficient way to estimate values at a fraction of the cost and time necessary to conduct multiple primary studies (TEEB, 2010). For more information about BTM, see Annex 1.

STAGE II: IMPACT ANALYSIS – QUANTIFY AND ASSESS

In the impact analysis stage of the EIA process, which requires a detailed analysis of significant effects, an ESV provides a framework to assess the impacts and dependencies of a proposed project and any alternatives. The following are best practices for performing an ESV that will also strengthen the impact analysis stage of the EIA process:

- Choose a valuation method that fits the needs of the project
- Assess how ecosystem services and stakeholders will be impacted by the project and alternatives
- Assess how the project and alternatives depend on ecosystem services
- Assess significant uncertainties

CHOOSE A VALUATION METHOD THAT FITS THE NEEDS OF THE PROJECT

Performing an ESV requires choosing a method to value or quantify ecosystem services. Many methods exist, and not all methods express values in monetary terms. However, estimating the economic value of ecosystem services ensures that development decisions recognize rather than ignore the value of nature. Many methods, both market-based and non-market-based, can be used to generate economic values. For more details on these methods the following resources may be consulted: Annex I, mission or bureau economists and USAID guidance documents. .

Capturing the economic values of ecosystem services can reveal the costs and benefits of different development decisions or scenarios. These values can be integrated into the EIA process to help determine how different scenarios or development proposals may positively or negatively impact ecosystem services and human well-being. Economic values are also central to tools such as cost-benefit analysis, accounting, asset management plans, return on investment calculations and payment for ecosystem services (PES) schemes.

Capturing the economic value of ecosystem services also allows the calculation of an asset value, or an estimate of the project's future value. As opposed to built capital, which tends to degenerate over time, natural capital tends to accrue. Calculating an asset value offers a time-dependent snapshot of those accruing benefits. The asset value of built capital – such as a road, levee, home or business – can be calculated as the net present value of its expected future benefits. In the same way that a home holds value year after year, natural capital also provides value overtime. If natural capital does not get degraded or depleted, the annual flow of ecosystem services will continue long into the future.

Box 8: Discount Rates

Discount rate defined – A discount rate allows for sums of money existing in different time periods to be compared by expressing values in present terms. In other words, discounting estimates how much future sums of money are worth today. Discounting takes two major factors into account: 1.) Time preference: people tend to prefer consumption now over consumption in the future, meaning a dollar today is worth more than a dollar received in the future. 2.) Opportunity cost of investment: investment in capital today provides a positive return in the future but renders those funds unavailable for other investment opportunities.

Recommended rates for natural capital - Public and private agencies vary widely in their standards for discount rates. The U.S. Federal Government recommends a discount rate of 2.75% for benefit-cost analysis for federal programs for 2018. See the Federal Government's *Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs*.

Why it matters - The choice of discount rate matters because it heavily influences the outcome of the present values of benefits that occur over a long period of time. Lower discount rates better demonstrate the value of long-term assets.

Values don't always translate to a price. Cultural values (a term used broadly here to refer to traditional, spiritual, social and subsistence values) can be difficult or impossible to quantify. These can have rich spiritual, emotional and ethical dimensions. For indigenous populations that fish or hunt to subsist, for example, replacement costs or market prices cannot capture the deep cultural significance embedded in those activities and the places in which they occur. Such populations may be justifiably resistant to any attempt to quantify this significance.

Cultural valuations cover a broad set of approaches. They tend to emphasize stakeholder participation as part of expressing individual and group perceptions of relationships between nature and well-being.

Despite the growing focus on cultural valuation methods and the growing number of scientific papers addressing them, these methods have yet to be formalized into any type of universal approach (Liu et al, 2010).

ASSESS HOW ECOSYSTEM SERVICES AND STAKEHOLDERS WILL BE IMPACTED BY THE PROJECT AND ALTERNATIVES

Because an ESV offers a framework for assessing impacts to the environment and human well-being, it serves as a useful tool for the Impact Analysis stage of the EIA process. An ESV allows a holistic assessment of how different development, management or land-use scenarios will affect ecosystem services and beneficiaries. It offers a way for USAID and IPs to assess the potential impacts of the project and project alternatives.

Impact significance hinges on the magnitude of the impact and the sensitivity of those affected. Magnitude can be assessed in terms of size, frequency, duration, reversibility and intensity of impact on the ecosystem service.. Sensitivity can be assessed by engaging the affected stakeholders to evaluate their responses to predicted changes in ecosystem service benefits. Sensitivity depends on the stakeholders' ability to adapt successfully to change (Landsberg et al, 2011).

The supply of ecosystem services will also be affected by factors external to the project. Five causes of ecosystem change are considered to have the greatest impact on supply of ecosystem services: (1) changes in local land use and land cover, (2) unsustainable harvest and resource consumption, (3) pollution, (4) introduction of invasive species and (5) climate change (Ash et al. 2010). To the extent possible, USAID and IPs should consider how such external factors could impact ecosystem function and services.

Box 9: Beyond the EIA: Payment for Ecosystem Services Protects Forests in Vietnam

In Vietnam, USAID support allowed the government to establish a national decree for Payment for Forest Environmental Services (PFES). The decree created a legal framework that facilitated payments to a variety of land managers in two pilot areas, Lam Dong and Son La provinces, for preserving forests and their associated ecosystem services. By 2010, payments of about $4.46 million were made to Forest Management Boards, forestry businesses and households. PFES activities have resulted in enhanced protection of over 200,000 hectares of threatened forest and a 50 percent decrease in illegal logging and wildlife poaching in the DaNhim watershed area (Winrock, 2011).

QUANTIFY PROJECT DEPENDENCIES ON ECOSYSTEM SERVICES

Because an ESV can help identify project dependencies (see Stage I), it can be used to quantify and assess risks in the performance of the project and project alternatives. An accurate assessment of such risk requires predicting the supply of priority ecosystem services over the lifetime of the project. USAID and IPs can then assess whether the predicted supply could prevent the project from achieving desired results (Landsberg et al, 2013).

ASSESS SIGNIFICANT UNCERTAINTIES

An ESV can provide a framework for uncertainty analysis. When possible, USAID and IPs should identify specific values and assumptions that deserve sensitivity analysis. Sensitivity analysis examines how uncertainty in the output of any model can be attributed to different sources of uncertainty in the inputs. By establishing a likely range of upper and lower values rather than relying on one average figure, sensitivity analyses can express impacts as probabilities rather than as certainties.

As part of the Impact Analysis stage of the EIA process, a sensitivity analysis can reveal which impacts are more or less likely. This knowledge can inform the decision about whether to proceed with a project or project alternative. For performing an ESV, the three main types of uncertainty affect valuations. These types are: uncertainty of the nature of the ecosystem services to be valued, uncertainty of the way people form preferences about ecosystem services, and uncertainty regarding the tools or techniques used to produce the valuation (Pascual and Muradian, 2010).

STAGE III: PLAN – MITIGATE AND MANAGE

An ESV can guide mitigation plans to be commensurate with project impacts. Knowing the potential impacts of projects and alternatives will allow USAID and IPs to mitigate and manage risks, avoiding the costliest decisions while promoting the most beneficial options.

MITIGATE OR IMPROVE PROJECT IMPACTS

An ESV naturally informs Environmental Mitigation and Monitoring Plans (EMMPs). By revealing project impacts and their magnitudes, an ESV reveals which impacts need the most attention. By following the established mitigation hierarchy, USAID and IPs can identify measures to avoid, minimize, restore and offset losses in ecosystem service benefits. Beyond helping to manage project impacts, an ESV may also reveal opportunities to enhance gains in ecosystem service benefits (Landsberg et al, 2013).

MANAGE PROJECT DEPENDENCIES

As with managing project impacts, USAID and IPs can identify cost-effective measures to manage risks that affect project performance. Projected losses in project performance could be managed, if possible, by increasing the ecosystem service supply required by the project.

Box 10: Beyond the EIA: Incorporating Ecosystem Services in National Law

In addition to gauging the impacts of proposed projects, the ESV process can be used to establish national laws that incentivize the protection and restoration of ecosystem services. In 2014, The Ministry of Environment in Peru ratified laws that establish a legal and technical framework to reward and share ecosystem services. The *Mecanismos de Retribución por Servicios Ecosistémicos* (MRSEs), or Mechanisms of Compensation for Ecosystem Services, law guides how both international and tariff funds can finance projects on the ground that protect watersheds, prevent deforestation and sequester carbon.

The MRSE law guides Reducing Emissions from Deforestation and forest Degradation (REDD) projects, which use an international trust fund to pay for approved carbon sequestration projects. The law has also allowed Peru's water utility regulator to apply over $130 million, generated by water tariffs, toward ecosystem service projects that improve water security.

APPLYING VALUATIONS IN DATA-SCARCE REGIONS

Until recently, ecosystem services frameworks have been applied primarily to aid decision making at regional and national scales. Mainly due to local data gaps, they have been applied in a limited way for mapping and modeling at the local scale (Pandeya et al, 2016). However, when working in data-scarce regions, use of techniques like benefit transfer, combined with knowledge generated by stakeholders within a community, can support decisions that benefit both ecosystems and human well-being.

To begin the process of assessing the impacts of a proposed project on ecosystem services, a general analysis tool like Figure 4 can be used by IPs as well as USAID project design teams, technical program staff, environment staff (such as mission environment officers) and IPs. Figure 4 can provide a baseline guide of the ecosystem services likely to exist in an area so that stakeholders can more easily identify priority ecosystem services that a project may affect. Local scientific and cultural knowledge may be used to supplement data gaps. Consult with your mission environment officer about what type of ecosystem your project is operating within.

ECOSYSTEM SERVICES PROVIDED BY DIFFERENT ECOSYSTEM TYPES

ECOSYSTEM GOODS AND SERVICES	MARINE	FRESHWATER	WETLANDS	FORESTS	GRASS & SHRUBLANDS	DRYLANDS	CULTIVATED	URBAN GREENSPACE
PROVISIONING								
Food	●	●	●	●	●	●	●	○
Medicinal Resources	○	○	●	●	○	○	○	○
Ornamental Resources	○		○	○	○		○	
Energy and Raw Materials	●	●	●	●	○	●	●	○
Water Storage	○	●	●	●	○	○	●	○
REGULATING								
Air Quality	○	○	●	●	○	●	●	●
Biological Control	○	○	○	●	○	○	●	○
Climate Stability	●	○	●	●	●	●	●	●
Disaster Risk Reduction	●	○	●	●	○	●	○	○
Genetic Transfer	●	●	○	●	○	○	●	○
Soil Formation	○	○	●	●	●	○	●	○
Soil Quality	○	○	○	○	●	○	●	○
Soil Retention	●	○	●	●	●	○	●	
Water Quality	●	●	●	●	●	○	●	●
Water Supply	○	●	●	●	●	●	○	●
Navigation	●	○						
SUPPORTING								
Habitat and Nursery	●	●	●	●	●	●	●	○
INFORMATION								
Aesthetic Information	●	●	●	●	●	●	●	●
Cultural Value	●	●	●	●	○	●	●	●
Recreation and Tourism	●	●	●	●	●	●	●	●
Science and Education	●	○	○	●	○	○	○	○

● = COMMONLY ASSOCIATED WITH ECOSYSTEM TYPE ○ = SOMETIMES ASSOCIATED WITH ECOSYSTEM TYPE BLANK = UNKNOWN

Figure 4. Table of common ecosystem services by different land types. (Source: Earth Economics 2018).

CONCLUSION

An ESV offers a complementary assessment of the environmental and social impacts of a project and project alternatives that are identified through USAID's EIA process. When integrated throughout the EIA process, an ESV helps to reveal impacts and project dependencies that may otherwise go unnoticed or unaddressed. By better understanding project impacts and dependencies, USAID and IPs can better manage project risks – both environmental and social – while also supporting USAID's stated environmental policy and development goals.

ANNEX 1

ADDITIONAL INFORMATION ON ECOSYSTEM SERVICES FRAMEWORKS

The Economics of Ecosystems and Biodiversity (TEEB) framework is like the Millennium Ecosystem Assessment (MEA) framework in that it follows the same four broad service categories: provisioning, regulating, cultural and supporting (Sukhdev et al, 2010). Additionally, the European Environment Agency is developing the Common International Classification of Ecosystem Services (CICES) to support environmental accounting. While it groups services into three categories (provisioning, regulation and maintenance, and cultural), it is perhaps the most detailed framework currently available, with over 60 individual ecosystem services delineated (Haines-Young et al, 2018).

SUMMARY OF PROS AND CONS OF THE BENEFIT TRANSFER METHOD

While the Benefit Transfer Method (BTM) offers an imprecise valuation, it also offers a cost- and time-effective way to ensure that nature gets valued. It often reveals a range of possible values. In practice, when deciding if or how to pursue a development project, a range of values may be sufficient to make an informed decision. When implementing small-scale projects in resource- or data-scarce areas, BTM can serve as an especially useful tool.

However, a benefit transfer approach can fail to capture a place's unique ecological and cultural context. While ecosystem services in different locations may share many similarities, services can differ in quality and accessibility, as well as in the cultural values that determine their use (Nelson et al, 2009).

ECONOMIC VALUATION METHODOLOGIES

The below list includes common methods used to capture economic values of ecosystem services. Please note: The list is not exhaustive.

REVEALED PREFERENCES

Market Value – The value of goods as determined by a market price. If products of ecosystem services, such as food or fiber, are sold in markets then it may be possible to infer the value of the ecosystem services that contribute to the provisioning of those goods.

Replacement Cost – The cost of replacing a given asset. This can be calculated as the cost of replacing a service provided by functional natural systems with man-made infrastructure. For example, one could calculate the cost of building and operating a water treatment plant to replace natural water filtration.

Avoided Cost – The cost of production that would have been incurred in the absence of a given service. For example, maintaining habitat for wild pollinators allows farmers to avoid the costs that would have been incurred by renting beehives.

Avoided Damages – The cost that would be incurred due to damage to property, goods, livelihoods, or other assets in the absence of a given service. For example, coastal mangrove forests and wetlands may protect against storm surges and reduce costs from expected damage.

Production Function – An estimate of the relationship between an increase in inputs and outputs. This approach can be used to model how production varies as a function of the supply of an ecosystem service, such as pollinators or pollinator habitat.

Travel Cost – The cost incurred due to visiting a site. Demand for some ecosystem services, namely recreation, can be estimated by the expenses that people make to visit a site.

Hedonic Pricing – An estimate of value based on the premise that the price of a marketed good is related to both the internal characteristics of a good as well as external factors that affect the good. Property values vary by proximity to some ecosystem services. For example, homes with water views often sell for higher prices than similar homes without such views.

STATED PREFERENCES

Contingent Valuation – An estimate of value based on surveys of the values assigned to certain activities. For example, this can be measured by a person's willingness-to-pay to protect a place or an endangered species.

VALUE TRANSFER

Unit Transfer – Uses values at a (remote) study site expressed as a value per unit (per unit area or per beneficiary) combined with information on the quantity of units at the project site.

Function Transfer – Uses a value function, or an equation relating the value of an ecosystem service to the beneficiaries, to estimate values at the project site.

Meta-Analysis – Uses a value function estimated from multiple primary studies to estimate the value of an ecosystem service at a project site.

VALUATION DATASETS FOR BENEFIT TRANSFER

The Environmental Valuation Reference Inventory (EVRI) – A searchable storehouse of empirical studies on the economic value of environmental assets and human health effects.

Ecosystem Valuation Toolkit (EVT) – Earth Economics' database of ecosystem service values. EVT holds thousands of values gleaned from ecosystem service value databases and peer-reviewed academic journals. The tool allows Earth Economics to quickly and reliably generate values for virtually any location and ecosystem in the world.

TEEB's Ecosystem Services Valuation Database (ESVD) – Based on estimates of values from the TEEB research project (www.teebweb.org), this database was developed in collaboration with the biome expert group, the valuation thematic working group, the Marine Ecosystem Services Partnership and the Ecosystem Valuation Toolkit (Earth Economics).

MAPPING RESOURCES

GLOBAL INFORMATION SERVICES

Q-GIS – Open source software that supports vector, raster and other database formats. Allows users to manage, edit and analyze data.

ESRI – Proprietary products include ArcMap, ArcGIS, ArcSDE, ArcIMS, ArcWeb services and ArcGIS Server.

OTHER MAPPING RESOURCES

Google Maps – Online map that uses satellite and web images. It can be used to identify basic landcover and likely ecosystem services in a proposed project area.

Google Earth Pro – Offline map that uses satellite imagery. It can be used to identify basic landcover and likely ecosystem services. It can also be used to draw shapes and calculate areas and distances.

Open Data Kit (ODK) – A mobile data collection application that can be used to collect data from the field. It allows users to aggregate collected data on a server and extract that data in useful format (map or graph).

Open Street Map (OSM) – Volunteer-generated geographical information that records GPS, images and audio data.

DATASET RESOURCES

LANDCOVER DATASETS

GlobeLand30 – The world's first global land cover datasets at a 30m Resolution. The datasets are freely available and comprise ten types of land cover, including forests, artificial surfaces and wetlands, etc., for the years 2000 and 2010. They were extracted from more than 20,000 Landsat and Chinese HJ-1 satellite images.

GADM database of Global Administrative Areas – GADM is a spatial database of the location of the world's administrative areas (or boundaries) for use in GIS and similar software. Data is downloadable in shapefile, KMZ, geodatabase and R formats.

World Wildlife Federation's HydroSHEDS – HydroSHEDS provides hydrographic information for regional and global-scale applications. It offers a suite of geo-referenced data sets (vector & raster) at various scales, including river networks, watershed boundaries, drainage directions and flow accumulations.

ENVIRONMENTAL IMPACT DATASETS

CCAFS-Climate – The CCAFS-Climate data portal provides global and regional future high-resolution datasets that serve as a basis for assessing climate change impacts and adaptation in a variety of fields including biodiversity, agriculture and livestock production, and ecosystem services and hydrology. The data are in ARC GRID and ARC ASCII format.

Earth Stat – Earth Stat offers geographic data sets related to agriculture's impact on the environment. Data includes the distribution of crops, climate impacts on crop yields and the impacts of fertilizer and manure.

IUCN Red List Threatened Species – The IUCN List of Threatened Species contains global assessments for just over 88,000 species, of which about two-thirds have spatial data. The data are available as ESRI shapefiles that contain taxonomic information, distribution status, IUCN Red List category, sources and other details.

SOCIOECONOMIC AND HEALTH DATASETS

Humanitarian Data Exchange (HDX) – The Humanitarian Data exchange includes over 6,600 datasets collected from governments, universities and humanitarian organizations all over the world.

United Nations Environmental Data Explorer – The Environmental Data Explorer is the authoritative source for data sets used by UNEP and its partners in the Global Environment Outlook (GEO) report and other integrated environment assessments. Its online database holds more than 500 different variables, as national, sub-regional, regional and global statistics or as geospatial data sets (maps), covering themes like freshwater, population, forests, emissions, climate, disasters, health and GDP.

World Health Organization (WHO) Global Health Observatory (GHO) Data – Organized by country, the GHO data repository contains an extensive list of indicators, which can be selected by theme or through a multi-dimension query functionality. It is the World Health Organization's main health statistics repository.

ECOSYSTEM SERVICES MODELING TOOLS

Artificial Intelligence for Ecosystem Services (ARIES) – ARIES is an open-source artificial intelligence and semantic modeling program. It can be used for ESVs and integrated into the decision-making process for conservation planning or PES schemes, but has limited uses for landcover change comparisons (Pandeya et al, 2016).

Integrated valuation of Ecosystem Services and Trade-offs (InVEST) – InVEST is an advanced model for quantifying and mapping multiple ecosystem services. It is widely used in policy and decision making for water and land resources management. It can be integrated into local decision-making processes but requires expert knowledge on GIS techniques and local data (Pandeya et al, 2016).

Multi-scale Integrated Model of Ecosystem Services (MIMES) – MIMES is an analytical framework designed to assess the dynamics associated with ecosystem service function and human activities. In MIMES, users formalize how materials are transformed between natural, human, built and social capitals. This information is used to forecast ecosystem services under alternative scenarios (Boumans et al, 2015).

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