Appendix 2 Alphabetical list, and short description, of tools, methods and models relevant to Ecosystem Service Assessment (v081216)

Name of tool or method	Abbreviation	Tye of tool or method	Related step(s)	Brief description	Basic source(s) or
Acting on Ecosystem Service Opportunities		Guideline	Step-0 Step-6 Step-7	The guidelines provide a detailed, step-by-step 'how to' guide for identifying and planning an economic instrument for conservation and for sustainable local development. The focus is on involving communities in areas with high biodiversity or important ecosystems and enhancing their stewardship role. Economic instruments can motivate people to change their behaviour in favour of more sustainable outcomes. The guidelines demonstrate how to identify opportunities to use economic instruments by considering four key economic principles: 'Steward Earns', 'Beneficiary Pays', 'Polluter Pays', and 'Innovation'. They subsequently assist in designing and implementing the selected instruments. The primary audience for the guidelines is the technical staff, consultants and researchers who will actually be involved in working through the steps and tasks on the ground	http://www.aboutvalues.net/method_database/#
Artifical Intelligence for Ecosystem Services	ARIES	Modelling Framework + Analysis tool	Step-2	• ARIES is a networked software that redefines ES assessment and valuation by mapping ES flows. • ARIES aims to quantify ES in a manner that acknowledges dynamic complexity and its consequences, but keeps its models sufficiently simple to remain tractable, general and scalable to varying levels of detail and data availability (Villa et al, 2014).	http://aries.integratedmodelling.org/ Villa et al., 2014 Villa et al., 2009
Bayesian Belief Network	BBN	Biophysical Model + Statistical framework	Step-1 Step-2 Step-3 Step-4 Step-5	• BBN is a diagrammatic representation of the socio-ecological systems, developed by pulling together the knowledge of scientists and practitioners about the supply and demand of ES. • BBN generates a framework of nodes and links to formalize the flows of information from ecology to economics and leads to a transparency about what is being presented	Loch Leven case study http://openness.hugin.com/caseStudies/LochLeven_Habitat
Benefit Transfer and Use Estimating Model Toolkit		Toolkit + Valuation Database	Step-4	• Publicly available spreadsheets, use function transfer to value changes in ecosystem services in the U.S.	http://dare.agsci.colostate.edu/outreach/tools/ Loomis & Richardson, 2008
Choice modellling		Economic method	Step-4	• A method of valuing goods and services based on their attributes. It is a stated preference technique whereby respondents' trade-off different levels of the attributes with payments to reveal the value of changes in the attributes	
Climate Change Integrated Assessment Methodology for Cross-Sectoral Adaptation and Vulnerability	CLIMSAVE	Web-based tool + Policy assessment	Step-1 Step-3 Step-5	• The CLIMSAVE impact assessment platform is a user-friendly, interactive web-based tool that allows stakeholders to assess climate change impacts and vulnerabilities for a range of sectors, including agriculture, forests, biodiversity, coasts, water resources and urban development. • The linking of models for the different sectors enables stakeholders to see how their interactions could affect European landscape change. Outputs from the linked models are translated into ES in order to link climate change impacts directly to human well-being.	http://www.climsave.eu/climsave/index.html Harrison et al., 2015
Contingent valuation		Economic method	Step-4	• Stated preference-based economic valuation technique based on a survey of how much respondents would be willing to pay for specified benefits	
Cost-benefit analysis	CBA	Economic method	Step-5	• A technique is designed to determine the economic feasibility of a project or plan by quantifying its economic costs and benefits	
Cost-effectiveness analysis	CEA	Economic method	Step-3 Step-4 Step-5	• A technique is to identify the least cost option to meets a particular goal.	
Co$ting Nature		Web-based tool + Policy assessment	Step-1 Step-2	• Co$ting Nature is a web based tool for analysing ES provided by natural environments, identifying the beneficiaries of these services and assessing the impacts of human interventions. This Policy Support System (PSS) is a tested for the development and implementation of development and conservation strategies focused on sustaining and improving ES and their environmental foundations.	https://ebmtoolsdatabase.org/tool/costing-nature-coting-nature http://www.policysupport.org/cos

				• It calculates the spatial distribution of ES for water, carbon, hazard mitigation and tourism and combines these with maps of conservation priority, threatened biodiversity and endemism to understand the spatial distribution of critical ecosystems. • The tool identifies the potential and realised services. These data are combined with analysis of current human pressures and future threats on ecosystems and their services in order to assess conservation priorities.	tingnature Brown et al., 2014
Damage cost avoided		Economic method	Step-3 Step-4	• Estimate damage avoided due to ecosystem service. Ecosystems that provide storm or flood protection to houses or other assets.	
Deliberative assessment		Socio-cultural methods	Step-2 Step-3	• Deliberative methods are group of tools and techniques (e.g. valuation workshops, citizens' juries, photo-voice, etc.) for engaging and empowering non-scientist participants – ask stakeholders and citizens to form their preferences for ecosystem services together through an open dialogue. These methods allow for the consideration of ethical beliefs, moral commitments and social norms beyond individual and collective utility, and are often used in combination with other approaches (e.g. mapping or monetary valuation).	
Defensive expenditure		Economic method	Step-4	• Expenditure on marketed goods that can substitute for ecosystem services	
Ecologicical Asset Inventory and Managament	EcoAIM	Proprietary tool	Step-1 Step-2	• EcoAIM is a tool to (1) inventory ecological services and help in making decisions regarding development, transactions, and ecological restoration; (2) develop specific estimates of ecosystem services in a geographically relevant context, and (3) offer the means for evaluating tradeoffs of ecosystem services resulting from different land or resource management decisions.	Booth et al., 2014
EcoMetrix		Proprietary tool	Step-2 Step-6	• EcoMetrix is one of propriety software systems that are designed to help local governments design and implement ES conservation programs, including payment for ES programs.	http://www.parametrix.com/
ECOPLAN		GIS based tools	Step-1 Step-2 Step-3 Step-4 Step-5	• ECOPLAN aims to create spatially explicit information and tools for the assessment of ES. These tools are for the evaluation of functional ecosystems as a cost-efficient and multi-purpose strategy to improve environmental quality. ECOPLAN will develop open source end-product to identify, quantify, value, validate and monitor ecosystem services. • 7 tools are developed under ECOPLAN; ECOPLAN monitor, ECOPLAN webviewer, ECOPLAN impact database, ECOPLAN QUICKScan, ECOPLAN Scenario evaluator, ECOPLAN Trade-off, ECOPLAN participation tool	https://www.uantwerpen.be/en/rg/ecoplan/
Ecosystem Porfolio Model	EPM	Web-based tool	Step-2	• EPM integrates ecological, socio-economic information and associated values of relevance to decision-makers and stakeholders. It uses a multi-criteria scenario evaluation framework, GIS analysis and spatially-explicit land-use/land-cover change-sensitive models to characterize changes in important land-cover related ecosystem values related to ES and functions, land parcel prices, and community quality-of-life metrics.	http://pubs.usgs.gov/sir/2009/5181/ Labiosa et al., 2013
Ecosystem Services Review	ESR	Guideline	Step-0 Step-1 Step-2	• ESR consists of a structured methodology that helps managers proactively develop strategies to manage business risks and opportunities arising from their company's dependence and impact on ecosystems. • Businesses can either conduct an ESR as a stand-alone process or integrate it into their existing environmental management systems.	Hanson et al., 2012
Ecosystem Valuation Toolkit	EVT	Toolkit	Step-4	• EVT gives nature a voice at the negotiating table by providing transparent and defensible monetary values for natural assets. • EVT offers researcher's library, SERVES (web-based tool for calculating ES values and performing natural capital appraisal), resources	http://esvaluation.org/
Environmental Profit & Loss Account	EP&L	Framework	Step-5	• An Environmental Profit and Loss Account (E P&L) is an effort to account, in financial terms, for the Ecosystem Services upon which a company and its entire value chain rely. It aims to place a monetary value on the environmental impacts of an organisation and its value chain. In the EP&L, the "Profit" refers to any company activity that benefits the environment, whereas the "Loss" refers to activities that adversely impact the environment. How is an EP&L applied?	Novo Nordisk 2014 (http://www2.mst.dk/Udgiv/publications/2014/02/978-87-93178-02-1.pdf)

				• Awareness and Transparency Tool • Identification of Environmental Hot Spots • Risk Management • Sustainable Supply Chain Management	
Environmental and Social Impact Assessment	ESIA	Guideline	Step-0 Step-1 Step-3	• ESIA is a way to identify, predict and assess the type and scale of potential biodiversity impacts, and opportunities to benefit conservation, associated with any business activities or projects.	Landsberg et al., 2011 www.ifc.org/BiodiversityGuide
EnVision		GIS based tools	Step 2	EnVision is an agent-based modelling platform where agents weigh the relative utility of potentially relevant policies to determine what policies, if any, they will select to apply at any point in time/space. It can be used to assess soil ES; hydrological ES; provisioning ES (e.g., timber, food); carbon storage and sequestration.	http://envision.bioe.orst.edu/
Ecosystem Services Review for Impact Assessment	ESR for IA	Guideline	Step-0 Step-1	• It provides practical instructions for ESIA practitioners to address ES in a systematic and efficient manner. • ESR for IA proposes a conceptual framework linking ecosystem services, human well-being and the project for which the ESIA is carried out.	Landsberg et al., 2011 Landsberg et al., 2014 http://www.wri.org/publication/ecosystem-services-review-impact-assessment
ESTIMAP		GIS-based model	Step-2	• ESTIMAP is a consistent and flexible set of spatially-explicit models each of which can be run separately for the assessment of different ES at the European scale.	Zulian et al., 2013 Zulian et al., 2014
ESValue		Proprietary tool	Step-2	• The ESValue decision support tool engages stakeholders in identifying ES and values. • It can help build a shared vision of resource management for diverse groups of stakeholders, and create a common language for discussion.	Frenchman Bay Partners, 2015
GISCAME	(formerly "Pimp Your Landscape")	GIS-based software	Step-1 Step-2	• GISCAME aims to evaluate land use based on available regional knowledge (empirical data, model results/reports, and expert knowledge) in order to provide a tool to weigh action alternatives for the planner. • GISCAME considers the landscape as an integrative layer for interactions between different land use types, land users, and ecosystem processes, which contribute to the provision of ecosystem services. The integrated evaluation and regulation system allows the formulation of parameters as well as the setting of conversion rules.	http://www.giscame.com/giscame/english.html Furst et al., 2013
Global Environmental Flow Calculator		Software	Step-1	Users of this software apply environmental flow curves – graphical representations of the percentage of time that rivers or streams reach specific discharges (m3/s) – to inform river management decisions. Healthy ecological functioning in rivers requires a minimum discharge. Users therefore find the tool helpful in: i) identifying anticipated hydrological implications of land use planning, and ii) making management decisions based on predicted flow regimes. A map interface allows the model user to view flow duration curves of six 'environmental management classes', ranging from "unmodified" to "critically modified" conditions, for their river of interest.	http://www.aboutvalues.net/method_database/#
GLOBIO		Modelling Framework	Step-1	• GLOBIO is a modelling framework to calculate the impact of environmental drivers on biodiversity for past, present and future. • GLOBIO is based on cause-effect relationships, derived from the literature. To use GLOBIO no detailed species data are needed. Instead, the model uses spatial information on environmental drivers as input.	Schipper et al., 2016 http://www.globio.info/home
Guidance for the Rapid Assessment of Cultural Ecosystem Services	GRACE	Guideline	Step-2	• GRACE defines cultural ecosystem services as encompassing environmental spaces (e.g. forests, gardens, desert, seascapes, farmland) and cultural practices (e.g. creating and expressing, producing and caring, playing and praying) that together give rise to the experience of valued material and non-material benefits (Church et al., 2014, UK National Ecosystem Assessment Follow-on. Work Package Report 5: Cultural ecosystem services and indicators. UNEP-WCMC, LWEC, UK). • Primarily aimed at conservation and development NGOs working with communities, GRACE is	https://www.iucn.org/content/guidance-rapid-assessment-cultural-ecosystem-services Infield et al., 2015

				intended to help decision makers recognise and understand the cultural benefits provided by the natural world, and take them into account in decisions about how to use and manage nature. • There are three key questions that are central to GRACE: (1) What aspects of nature do people benefit from? (2) How do these contribute to well-being, and to whose? (3) How might changes affect the delivery of these services and the well-being derived from them?	
Group/ participatory valuation		Economic method	Step-4	• Asking groups of stakeholders to state their willingness to pay for an ES through group discussion	
Hedonic pricing		Economic method	Step-4 Step-5	• Estimating influence of environmental characteristics on price of marketed goods (usually houses)	
Integrated Biodiversity Assessment Tool	IBAT	Web-based tool	Step-2	• IBAT provides up-to-date biodiversity information to decision-makers from the private and public sectors through a single, reliable web-resource. • IBAT provides companies and government agencies with globally compiled spatial and tabular data drawn from established sources on protected areas (World Database on Protected Areas), sites of global conservation importance (Key Biodiversity Areas, including Important Bird Areas and Alliance for Zero Extinction sites) and globally threatened species (the IUCN Red List). • IBAT comprises a 'family' of web-based tools, in different sectors, ranging from conservation science to corporate business. a) IBAT for business b) IBAT for Research and conservation)	http://www.birdlife.org/datazone/sowb/casestudy/254 https://www.ibatforbusiness.org/ https://www.ibat-alliance.org/ibat-conservation/login
Influence and Importance Matrix - Identifying target groups		Socio-cultural method	Step-7	• To communicate the value of an ES to decides what the target groups are and hence – which tools and methods of communication are most efficient and worth to invest in.	http://www.managingforimpact.org/tool/influence-and-importance-matrix
Integrated Valuation of Ecosystem Services and Tradeoffs	InVEST	GIS-based software	Step-1 Step-2 Step-3 Step-5	• Open-source software model for ES mapping and valuation through ArcGIS • InVEST can assess quantified trade-offs within alternative management choices and to identify areas where investment in natural capital can enhance human development and conservation. • InVEST currently have 18 ES models for terrestrial, freshwater, marine, and coastal ecosystems and it can assess the changes in ecosystem function or ES through scenario analysis. • InVEST can be used to design analytically-rigorous environmental and social impact assessments (ESIAs) by quantifying the expected losses and gains of ES from development proposals	http://www.naturalcapitalproject.org/invest/ Sharp et. al., 2016
Intergovernmental Platform on Biodiversity and Ecosystem Services	IPBES	Framework	Step-0 Step-3 Step-7	• The conceptual framework for biodiversity and ecosystems services is to support the analytical work of the Platform, to guide the development, implementation and evolution of its work programme, and to catalyse a positive transformation in the elements and interlinkages that are the causes of detrimental changes in biodiversity and ecosystems and subsequent loss of their benefits to present and future generations	www.ipbes.net/conceptual-framework
i-Tree (Tools for Assessing and Managing Forests and Community Trees	i-Tree	GIS-based software	Step-1 Step-2	• i-Tree is peer-reviewed software suite from the USDA Forest Service that provides urban and rural forestry analysis and benefits assessment tools. It helps to strengthen the forest management and advocacy efforts by quantifying the structure of trees and forests, and the environmental services that trees provide	http://www.itreetools.org/
Language recommendations		Socio-cultural method	Step-7	• If communicating the value of ecosystems to the public, there are some useful tips on how to formulate the message in a way that people tend to react more positively to.	https://www.conservationgateway.org/Documents/Summary%20Memo%20Polling.pdf
Land Utilisation & Capability Tool (formerly Polyscape)	LUCI	GIS toolbox	Step-1 Step-2	• LUCI explores the capability of landscape to provide a variety of ES. It compares the services provided by the current utilization of the landscape to estimates of its potential capability and uses this information to identify areas where change might be beneficial and where maintenance of the status might be desirable. • Open source GIS toolbox to map areas providing services and potential gain or loss of services under management scenarios	http://www.lucitools.org/ Jackson et al., 2013
Macro-ecological models		Biophysical models	Step-1 Step-2	• Models that assess ES supply based on the presence (or abundance) of specific components of biodiversity, referred to as Ecosystem Service Providers (ESP) or Service Providing Units (SPU), depending on their geographic distribution. The contribution of e.g. different species or functional groups to the ES of interest is assessed based on specific traits (e.g. trophic guilds)	

				or expert knowledge.	
Marxan		Modelling Analysis Software		• It is land-use planning software allows to strategically place conservation areas in the landscape based on ecosystem services and opportunity costs. It can be used when asking how to optimize the spatial provision of biodiversity and ES and plan protected areas to maximize both biodiversity and ES provision. Marxan is a standalone program. However, since output is provided in text or comma-delimited files, a GIS mapper such as ArcGIS is needed to display the results so they can be better visualized.	http://www.aboutvalues.net/data/method_navigator/values_method_profile_marxan.pdf
Millennium Ecosystem Services Assessment Framework	MA	Framework	Step-0	• MA focuses on how humans have altered ecosystems, and how changes in ecosystem services have affected human well-being, how ecosystem changes may affect people in future decades, and what types of responses can be adopted at local, national, or global scales to improve ecosystem management and thereby contribute to human well-being and poverty alleviation.	http://www.millenniumassessment.org/en/index.html
Multi-scale Integrated Models of Ecosystem Services	MIMES	Modelling Framework	Step-1 Step-2	• MIMES is an open source dynamic modelling system for mapping and valuing ES. It is a suite of models for land use change and marine spatial planning decision making by quantifying the effects of land and sea use change on ES and can be run at global, regional, and local levels. • MIMES, an analytical framework designed to assess the dynamics associated with ES function and human activities. It integrates diverse types of knowledge and elucidate how benefits from ES gained and lost. MIMES formalizes how materials are transformed between natural, human, built and social capital. and due to analyzing multiple ecological and human dynamics, outputs can be interpreted through different temporal and spatial lenses to assess the effects of different actions in the short and long term and at different spatial scales (Boumans et. al, 2015)	http://www.afordablefutures.com/orientation-to-what-we-do/services/mimes Boumans et. al, 2015 Altman et al., 2012
Multi-criteria analysis	MCA	Assessment method	Step-3 Step-5	• It is an applicable assessment method in the situation that the relevant criteria (costs and benefits) to the decision cannot be expressed in monetised values, but can only be expressed in other units or in qualitative terms (i.e. impacts can be ranked in order of importance)	
Narrative assessment		Socio-cultural methods	Step-2 Step-3	• Narrative methods (e.g. in-depth and semi structured interviews, observations, voice and video recording of events, artistic expressions) allow research participants to articulate the plural and heterogeneous values of ecosystem services through their own stories and direct actions.	
Natural Assets Information System	NAIS	Valuation Datab	Step-4	• Proprietary valuation database paired with GIS mapping of land-cover types for point transfer	https://sig-gis.com/ecosystem-services/ Troy & Wilson, 2006
Natural Capital Protocol		Framework	Step-0 Step-3 Step-5	• The Natural Capital Protocol is a framework designed to help generate trusted, credible, and actionable information that business managers need to inform decisions. Until now, natural capital has for the most part been excluded from decisions and when it is included it has been largely inconsistent, open to interpretation or limited to moral arguments. The Protocol responds by offering a standardized framework to identify, measure and value impacts and dependencies on natural capital.	http://naturalcapitalcoalition.org/
Net factor income		Economic method	Step-4	• Revenue from sales of environment-related good minus cost of other inputs. Ecosystems that provide an input in the production of a marketed good.	
Net-Map Tool		Socio-cultural method	Step-2	Net-Map is an interview-based mapping tool that helps people understand, visualize, discuss, and improve situations in which many different actors influence outcomes. By creating Influence Network Maps, individuals and groups can clarify their own view of a situation, foster discussion, and develop a strategic approach to their networking activities. the Net-map tool allows participants to elicit their views on who the key actors are, what their main characteristics are, and how these actors are connected with each other, within the wider institutional context. This can help people to understand why natural resources are being used in a particular way, in a particular area. This tool is useful for an initial scoping exercise prior to an ecosystem service assessment. It is relatively simple to apply and requires not much more than pen and paper – and advanced experience in conducting open interviews and interpreting qualitative empirical data.	http://www.aboutvalues.net/method_database/# https://netmap.wordpress.com/about/
Offset Portfolio Analyzer and Locator	OPAL	GIS-based softw	Step-1 Step-2	• OPAL is a software tool, which maps and quantifies the impacts of development on habitat and ecosystem services, and facilitates the selection of mitigation activities to offset losses.	Mandle et al., 2016

Open Nonpoint Source Pollution and Erosion Comparison Tool	Open NSPECT	GIS-based softw	Step-1	This software estimates surface water volumes, pollutant concentrations, and sediment loads, mapping their spatial distribution on land and at the coastal interface. Users can input land use scenarios to predict future water quality in rivers, lakes, and marine bodies of water. Open NSPECT can be used to select development strategies that minimize adverse impacts on water quality-enhancing ecosystem services. It can also be used to identify cost-effective solutions to restore these ecosystem services. Model outputs are nitrogen, phosphorous, and suspended solids, estimated for simulated land cover types.	https://coast.noaa.gov/digitalcoast/tools/opennspect?redirect=301ocm
Our Ecosystem web-mapping platform	OE	Mapping tool	Step-6 Step-7	OE - Our Ecosystem is a web-based mapping platform for communicating and visualising spatial information about the environment. OE apps give access to spatial data from satellites and other sources. Currently, eight apps are freely available, e.g. showing carbon storage potential of changes in agricultural practice (example: in Malawi); revealing linkages between armed conflict and fire incidents in sub-Saharan Africa. New apps can also be developed for user-defined areas of interest	http://www.aboutvalues.net/method_database/#
Q-Methodology		Socio-cultural method	Step-1 Step-2 Step-3 Step-7	• Q-methodology is particularly useful when researchers wish to understand and describe the variety of subjective viewpoints on an issue. The name "Q" comes from the form of factor analysis that is used to analyze the data. Normal factor analysis, called "R method," involves finding correlations between variables (say, height and age) across a sample of subjects. Q, on the other hand, looks for correlations between subjects across a sample of variables. Q factor analysis reduces the many individual viewpoints of the subjects down to a few "factors," which are claimed to represent shared ways of thinking.	
Participatory mapping and assessment of ecosystem services	PGIS	Socio-cultural method	Step-2	• PGIS evaluates the spatial distribution of ecosystem services according to the perceptions and knowledge of stakeholders via workshops and/or surveys. PGIS allows for the participation of various stakeholders in the creation of an ES map (e.g. community members, environmental professionals, NGO representatives, decision-makers) and integrates their perceptions, knowledge and values in the final maps of ecosystem services.	
Payment of Ecosystem Services	PES	Socio-cultural + Economic Method	Step-6	• PES is a mechanism to reward communities for practices that keep the ecosystems surrounding them intact and well maintained so that they provide services that are useful for human well-being. This can be done using money or other incentives provided by the users of the services an example is implementing taxes or tariffs to the society as a whole or the key users of the service.	Kolinjivadi et al., 2015 http://www.teebweb.org/media/2012/01/TEEB-For-Business.pdf
Phenomenological models		Bopyhsical models	Step-1 Step-2	• Describe qualitative or semi-quantitative relationships between biodiversity components and ES supply, based on an understanding of biological mechanisms underpinning ES supply. They assume a relationship between elements of the landscape – quite often represented by land cover or land use classes – and the provisioning of and/or the demand for ecosystem services. In difference to purely empirical approaches parameters (or a part of the parameters) are not derived from observed data from the location of the model application. Instead parameters are transferred from other studies or meta-analysis.	
Photo-elicitation surveys		Socio-cultural method	Step-2	• Photo-elicitation surveys, although still quantitative by nature, follow a different logic to explore and translate people's visual experiences and perceptions of landscapes related to ecosystem services. It is based on the simple idea of inserting a photograph into a research interview. The difference between interviews using images and text, and interviews using words alone lies in the ways we respond to these two forms of symbolic representation. This is some of the reasons why photo elicitation interview are not simply an interview process that elicits more information, but rather one that evokes a different kind of information.	
Polyscape		GIS toolbox	Step-2	• Polyscape is an ecosystem service mapping approach that uses both local and expert knowledge to generate a representation of local landscape structures, showing areas of potential and actual ES generation. It is a multi-criteria GIS toolbox to identify and communicate synergies, trade-offs and opportunities related to ecosystem services under different land uses and protective actions. Polyscape is designed to facilitate a more spatially sensitive and explicit implementation of policies and regulations. It also supports policy implementation across sectors (e.g., water, biodiversity, agriculture and forestry), and the engagement of different stakeholder groups.	http://www.polyscape.org/

Preferences assessment		Socio-cultural method	Step-2	• Preference assessment is a direct consultative method to demonstrate the social importance of ecosystem services by analysing social motivations, perceptions, knowledge and associated values of ecosystem services demand or use. Data can be collected through free-listing exercises, ecosystem service ranking, rating or selection mechanisms	
Protected Area – Benefits Assessment Tool	PA-BAT	Framework	Step-3	• The PA-BAT has been primarily designed for use by protected area managers to work with stakeholders to identify important values and the benefits that they bring to a range of stakeholders, from local to global. • The PA-BAT can also be used by local communities to identify values/benefits and by protected area advocates, such as NGOs, to help promote the range of benefits a protected area can bring. Because the tool has developed a standard typology of values and benefits the results from the tool can be aggregated to provide an overview of a portfolio of protected areas (e.g. regional groups, national systems, biome groups etc). This can be used as a planning tool at system level (e.g. developing policies for specific resource uses) or as an advocacy tool for supporting protected areas. • The PA-BAT aims to help collate information on the full range of current and potential benefits of individual protected areas. It is a contributory methodology for the overall Arguments for Protection series, but is also hopefully a stand-alone tool that will be of wider use to the protected areas community. Although developed primarily for use in protected areas, the tool could have wider application, for example in assessing wider benefits of forest management units, agricultural landscapes or areas set aside for recreation.	http://wwf.panda.org/wwf_news/?174401/PABAT Stolton & Dudley, 2009
Production function		Economic method	Step-4 Step-5	• It is statistical estimation of production function for a marketed good including an ecosystem services input. It can be assessed ecosystems that provide an input in the production of a marketed good. • It is useful to answer the question of how much do ecosystem services contribute to other income and production processes? Ecosystem services are assessed and quantified by looking at the (monetary and/or non-monetary) changes in production that result from ecosystem change. In principle, any production or consumption process that uses ecosystem services as an input or depends on them for output is amenable to the application of this technique. Effect on production methods are most commonly applied to regulating and supporting services (e.g. pollination, soil productivity, water flow regulation, fisheries breeding and habitat).	http://aboutvalues.net/data/method_navigator/values_method_profile_effect_on_production.pdf
Process-based models		Biophysical models	Step-1 Step-2	• They rely on the explicit representation of ecological and physical processes that determine the functioning of ecosystems. They provide functional means of plant and ecosystem processes that are universal rather than specific to one biome or region. One purpose of such models is to explore the impact of perturbations caused by climatic changes and anthropogenic activity on ecosystems and their biogeochemical feedbacks. Many process-based models allow the net effects of these processes to be estimated for the recent past and for future scenarios. In terms of ecosystem services, these types of models are most widely applied to quantify climate regulation, water supply from catchments, food provision but also in the wider frame of habitat characterisation.	
Public Pricing		Economic method	Step-4	• It is used for ecosystem services for which there are public expenditures. Public expenditure or monetary incentives (taxes/subsidies) for ecosystem services as an indicator of value.	
Replacement cost		Economic method	Step-4	• It estimates the cost of replacing an ecosystem services with a man-made service. It has some limitations as; 1) no direct relation to ES benefits, 2) Over-estimates value if society is not prepared to pay for man-made replacement, 3) Under-estimates value if man-made replacement does not provide all of the benefits of the original ecosystem.	
Resource Investment Optimization System	RIOS	GIS-based softw	Step-6	RIOS provides a standardized, science-based approach to watershed management. RIOS is an open source software that supports the design of cost-effective investments in watershed services. It combines biophysical, social, and economic data to help users identify the best locations for protection and restoration activities in order to maximize the ecological return on investment, within the bounds of what is socially and politically feasible. RIOS processes and presents scientific information in a way that is useful for managers. The software is flexible	http://www.naturalcapitalproject.c pubs/ScienceChronicles2012-08_RIOS.pdf

				enough to be applied in many different environmental, social, and legal contexts. RIOS can facilitate the design of investments for a single management goal or several at once, including erosion control, water quality improvement (for nitrogen and phosphorus), flood regulation, groundwater recharge, dry season water supply, and terrestrial and freshwater biodiversity.	
Restoration cost		Economic method	Step-4	• It estimates the cost of restoring degraded ecosystems to ensure provision of ecosystem services. It can be applied any ecosystem services which can be provided by restored ecosystems.	
Restoration Ecosystem Service Tool Selector	RESTS	Framework	Step-0	• RESTS framework that describes key characteristics of 13 ES assessment tools*. Tools are filtered and presented based on five evaluative criteria: scalability, cost, time requirements, handling of uncertainty, and applicability to benefit-cost analysis. (*RESTS framework uses comperative content of different assessment tools as ARIES, Costing Nature, EcoMetrix, EnSym, Envision, ESR for IA, EVT, InVEST, LUCI, MIMES, NAIS, SolVES, TESSA)	Christin et al., 2016
Scenario planning		Socio-cultural method	Step-1 Step-2	• Scenario planning applies various tools and techniques (e.g. individual interviews, brainstorming or visioning exercises in workshops, often complemented with modelling) to develop plausible and internally consistent descriptions of alternative future options. Assumptions about future events or trends are questioned, and uncertainties are made explicit to establish transparent links between changes of ecosystem services and human well-being.	
Simulation of Terrestrial Environments	SITE	Framework	Step-1 Step-2	The SITE framework is a generic modelling platform supporting spatially explicit land-use modelling. It can combine different datasets to analyse the suitability of a certain region for a specific land use, e.g. the potential for an agricultural use. Furthermore, land use scenarios can be developed based on various drivers, such as regulations and regional preferences. Results can be used to describe probable impacts of land management decisions, e.g. as input for regional spatial planning. Typical outcomes from SITE are annual maps of past and expected future land use change. SITE is best suited for regional applications and it simulates land use decisions in annual time steps that represent different terrestrial sub-systems, e.g. settlements, forests. New modules can be added, and other models on decision making or biophysical processes can also be employed.	http://www.ufz.de/index.php?en=37508
Social Values for Ecosystem Services	SolVES	GIS toolbox	Step-2 Step-4	• SolVES is GIS tool to assess, map, and quantify the social values of ES particularly cultural services, such as aesthetics and recreation which can be evaluated for various stakeholder groups. • SolVES maps ES based on survey data and value transfer	http://solves.cr.usgs.gov/ Sherrouse et al., 2015 Sherrouse et al., 2011
Soil and Water Assessment Tool	SWAT	Ecosystem assessment Tool	Step-2	SWAT is mainly developed to evaluate the impact of agricultural management practices (e.g. crop rotations, tillage operations, fertilizer applications, or conservation practices such as terraces or filter strips) on catchment hydrology and water quality. SWAT is a process-based, spatially semi-distributed watershed model that can be used to predict a wide range of biophysical variables at a daily resolution. SWAT outputs are also used as indicators for several ecosystem services related to water (e.g. provisioning of fresh water, water purification) and biomass production (e.g. provisioning of food and/or bioenergy crops), as well as to assess trade-offs among such services. It has been proven to be an effective tool for assessing water resources and non-point source pollution problems for a wide range of scales and environmental conditions across the globe.	http://swat.tamu.edu/
Spatial-proxy models		Biophysical mod	Step-1 Step-2	• Spatial proxy models are related ES indicators to land cover, abiotic and possibly biotic (although not often used beyond vegetation type) variables by way of calibrated empirical relationships. Therefore, they can provide the most basic form of incorporation of 'biodiversity' effects on ES supply. It is desirable, and in practice most common for such models to be derived from well-known causal relationships between environmental variables.	
Spreadsheet methods		Biophysical methods	Step-2	• Spreadsheet-type methods (also known as matrix methods) are a quick and simple way to get an overall spatially-explicit picture of the ecosystem serbices in a spatial explicit manner and can involve stakeholder/ expert perception. The method is based on the idea of linking tabular spreadsheet data and spatial data together, i.e. joining external datasets to spatial units to	

				create maps. The spreadsheet format data can be collected, for example, as expert evaluation or constructed from indicators or statistics. Simple application of the approach typically involves land use or land cover (LULC) datasets, although other datasets can be used (EU FP7 OpenNESS Project Deliverable 3.2, 2015).	
State and transition model		Biophysical models	Step-1 Step-2	• State-and-transition models (STMs) are conceptual models of ecosystem dynamics after disturbances based on alternate state theory. In contrast to succession theory, which predicts that ecosystems recover from disturbances and return to a reference (undisturbed) state, alternate state theory maintains that disturbances may trigger a regime shift in critical processes (e.g. population recruitment, nutrient cycling) that will maintain the ecosystem in a state that differs from the reference state. The new state has different structural properties (e.g. functional diversity, species composition and dominance) from the reference state. The disturbances that trigger these changes are natural factors (e.g. droughts, windfalls, fire), management (e.g. clear-cutting, grazing by domestic animals), and the interactions among them; and the shifts in ecosystem condition that they trigger are irreversible in the absence of specific interventions. STMs acknowledge non-linear responses of ecosystem properties to human interventions; alternate states represent abrupt changes in ecological properties (EU FP7 OpenNESS Project Deliverable 3.2, 2015).	
Story Maps by ESRI		Communicating tool	Step-7	Story Maps can be used for presenting messages and visualising results of a study or an ecosystem service assessment. It is a way to inform and engage people with your story that involves spatial information, or reference to places, landscapes, regions. Story Maps provides a list of different application templates, which can be used for building and/or illustrating your story. Users can add your data in many different formats, including tabular data from spreadsheets. It is possible to combine these data with authoritative data published by esri and many other leading agencies. Most of the apps have interactive builders that make it easy to assemble your story. This method profile provides some key aspects of Story Maps and how this method is applicable for conveying an ecosystem services perspective.	http://storymaps.arcgis.com/en/
Strategic Environmental Assessment	SEA	Method	Step-1 Step-2 Step-3	• SEA is a potential tool to integrate ecosystem services in strategic decisions and improve the understanding of the consequences of policies, plans and programs on human wellbeing.	UNEP, 2014 OECD, 2010
Spatial Tools for River basins and Environment and Analysis of Management	STREAM	GIS-based software	Step-2	STREAM is a model-based method for informing decision makers about options to protect the hydrologic ecosystem services that secure water resources in coastal watersheds. STREAM provides a holistic approach to analyse the connectivity between upland resources and marine resources in coastal watersheds.	http://www.biodiversity.ru/coastlearn/planning-eng/stream.html
System of Environmental-Economic Accounting	SEEA Central Framework	Framework	Step-5	• SEEA Central Framework is a multipurpose conceptual framework that describes the interactions between the economy and the environment, and the stocks and changes in stocks of environmental assets. • Using a wide range of information, the SEEA Central Framework, through its structure, enables source data to be compared and contrasted and allows for the development of aggregates, indicators and trends across a broad spectrum of environmental and economic issues. The Central Framework organizes and integrates the information on the various stocks and flows of the economy and the environment in a series of tables and accounts.	UN, 2014
The Economics of Ecosystems and Biodiversity	TEEB	Framework	Step-0 Step-1 Step-2 Step-3 Step-4 Step-5 Step-6 Step-7	• TEES's objective is to mainstream the values of biodiversity and ecosystem services into decision-making at all levels. It aims to achieve this goal by following a structured approach to valuation that helps decision-makers recognize the wide range of benefits provided by ecosystems and biodiversity, demonstrate their values in economic terms and, where appropriate, capture those values in decision-making.	http://www.teebweb.org/
Time-use assessment		Socio-cultural method	Step-4	• This method estimates the value of ecosystem services by directly asking people how much time they are willing to invest (WTI) for a change in the quantity or quality of a given ecosystem service or conservation plan. Methodological is in the same line as preference	

				assessment, but with the objective to create a new indicator to measure social support towards conservation, time use studies create hypothetical scenarios for willingness to invest time	
Toolkit for Ecosystem Services Site-based Assessment	TESSA	Toolkit	Step-0 Step-1 Step-2 Step-3 Step-4 Step-5 Step-6 Step-7	• TESSA provides practical guidance on how to identify which services may be significant at a site of interest, what data are needed to measure them, what methods or sources can be used to obtain the data and how to communicate the results. • TESSA provides a net benefits framework through applying a set of appropriate methods for two alternative states of a site. It recommends use of existing data where appropriate and places emphasis on enabling users to collect new field data at relatively low cost and effort. • TESSA emphasises the importance of comparing estimates for alternative states of a site (ex: before and after conversion to agriculture) so that decision-makers can assess the net consequences of such a change, and hence the benefits for human well-being that may be lost through the change or gained by conservation (Peh et al., 2013b)	http://tessa.tools/ Peh et al., 2013a Peh et al., 2013b
Trait-based models		Biophysical models	Step-2	• Trait-based models quantify ES supply based on (statistical) relationships between functional traits of Ecosystem Service Providers (ESP) and ecosystem properties considered either by experts or by stakeholders to support a given ecosystem service (EU FP7 OpenNESS Project Deliverable 3.2, 2015).	
Travel cost		Economic method	Step-4	• Economic valuation techniques that use observed costs to travel to a destination to derive demand functions for that destination.	
UNEP-SETAC guideline on LCA (Life Cycle Asesment)		Guideline	Step-0 Step-1 Step-2 Step-3 Step-5	• Life Cycle Assessment (LCA) is a tool to support decision making widely used to assess the potential environmental impacts of a given product/service at each step of its life cycle.	Koellner et al., 2013
Value transfer		Economic method	Step-3 Step-4	• It is the use of research results from existing primary studies at one or more sites or policy contexts ("study sites") to predict welfare estimates or related information for other sites or policy contexts ("policy sites").	
World Overview of Conservation Approaches and Technologies database	WOCAT	Database	Step-1 Step-2	WOCAT provides a global open-access database for documenting, evaluating and disseminating on sustainable land management (SLM) practices for soil and water conservation. It allows searching for tools and case studies from all over the world, according to different criteria (e.g. geographic scope, target group, thematic issue, etc.). WOCAT does not assess ecosystem services, but focuses on efforts to prevent and reduce land degradation. This can enhance the provision of various ecosystem services (e.g. fresh water, erosion prevention, moderation of extreme events, soil fertility, etc.). WOCAT is provided by a network of over 60 institutions worldwide. The aim is to improve land use and livelihood through sharing knowledge about sustainable land management, networking for sustainable land management specialists, and developing standardized tools and methods for knowledge management and decision support.	https://www.wocat.net/