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WORKING PAPER #2

SOCIO-ECONOMIC DIMENSIONS OF HUMAN DEPENDENCE ON NATURE

A REVIEW OF CONCEPTUAL FRAMEWORKS, TOOLS AND METHODOLOGIES USED IN ASSESSMENTS

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1. INTRODUCTION

IUCN has been mandated by its members to develop a practical framework that is capable of systematically generating new insights on human dependence on natural systems that can:

- Inform policy formulation by addressing ecosystem values including the social dimensions of livelihood strategies and the cultural, economic and political drivers of natural resource use. Thus research into the wider socio-economic and anthropological context is required.
- Improve policy and programme implementation using an evidence-based approach based on systematically collected data on household-level use of wild resources and on the livelihood strategies of indigenous peoples and local communities which provides a fuller picture of the human-nature dynamics.

The aim of the Human Dependence on Nature (HDN) initiative[1] is to develop a suitable 'framework' (i.e. a way of looking at things) that can be used to explain social and economic aspects of human dependence on nature, particularly for food and nutrition security. The framework will also guide the type of data that needs to be collected and analysed in the development and implementation of the framework.

The framework can then be used by donors etc. to develop policies and programmes at different scales that protect and improve security as a means of poverty alleviation and livelihood protection.

Key issues that a framework should address include the following:

(i). Which types of (ecosystem) goods and services do rural (including coastal) communities depend on nature for? (e.g. provisioning and regulating services)

(ii). How important are these goods and services for these communities (how can they be valued?)

(iii). How do communities decide how to allocate resources to obtain the benefits these goods and services can provide? (what strategies are commonly used, e.g. risk aversion, minimal effort, distribution)

(iv). What are the major driving forces which affect the ability of communities to gain and continue to gain the above benefits, and how do communities respond to these forces and pressures positively and negatively?

(v). What strategies can donors use to reduce the negative impacts of driving forces that damage the ability of communities to (continue to) gain benefits from nature? e.g. by increasing socio-economic resilience, improving governance arrangements etc.).

This paper consists of a review of socio-economic conceptual frameworks, tools and methodologies relevant to HDN, and looks at the different (socio-economic) conceptual frameworks and techniques that could be used to address topics (i)–(iv) above. (Point (v) is a policy question and is not discussed in this paper). Case studies are used throughout the paper to illustrate how particular conceptual frameworks and tools have been used to explain socio-economic dimensions of human dependence on nature.

A framework is defined in this paper as a group of concepts that are defined and organised to provide a focus, a logic, and a tool for integrating and interpreting information.[2] Tools and methodologies are defined as the techniques that can be used to estimate impacts, values and other aspects of human interactions with the natural environment within the rationale and principles of particular conceptual frameworks.

The paper considers HDN in the context of rural inland and coastal communities, which obtain a high proportion of the goods and services on which they depend for their livelihoods directly, or nearly directly from nature.

The terms 'nature', and 'natural environments' are used synonymously throughout this paper. The report also refers to conceptual frameworks and analytical frameworks, which for the purposes of this paper are regarded as generally synonymous.

1.1 Ecosystem services and human dependence on nature

This section of the paper considers some ways in which individuals, households, businesses, and economies depend on nature for goods and services used for direct and indirect consumption.

A valuable starting point for considering such dependence is to use an ecosystem services perspective to categorise human uses of the natural environment. The Millennium Ecosystem Assessment (MEA) (2005) categorised goods and services humans obtain from the natural environment into four groups i.e. supporting, provisioning, regulating and cultural services. These services contribute to human well-being in a variety of ways, as shown in Figure 1 below.

It can be argued that the category of cultural services origi-

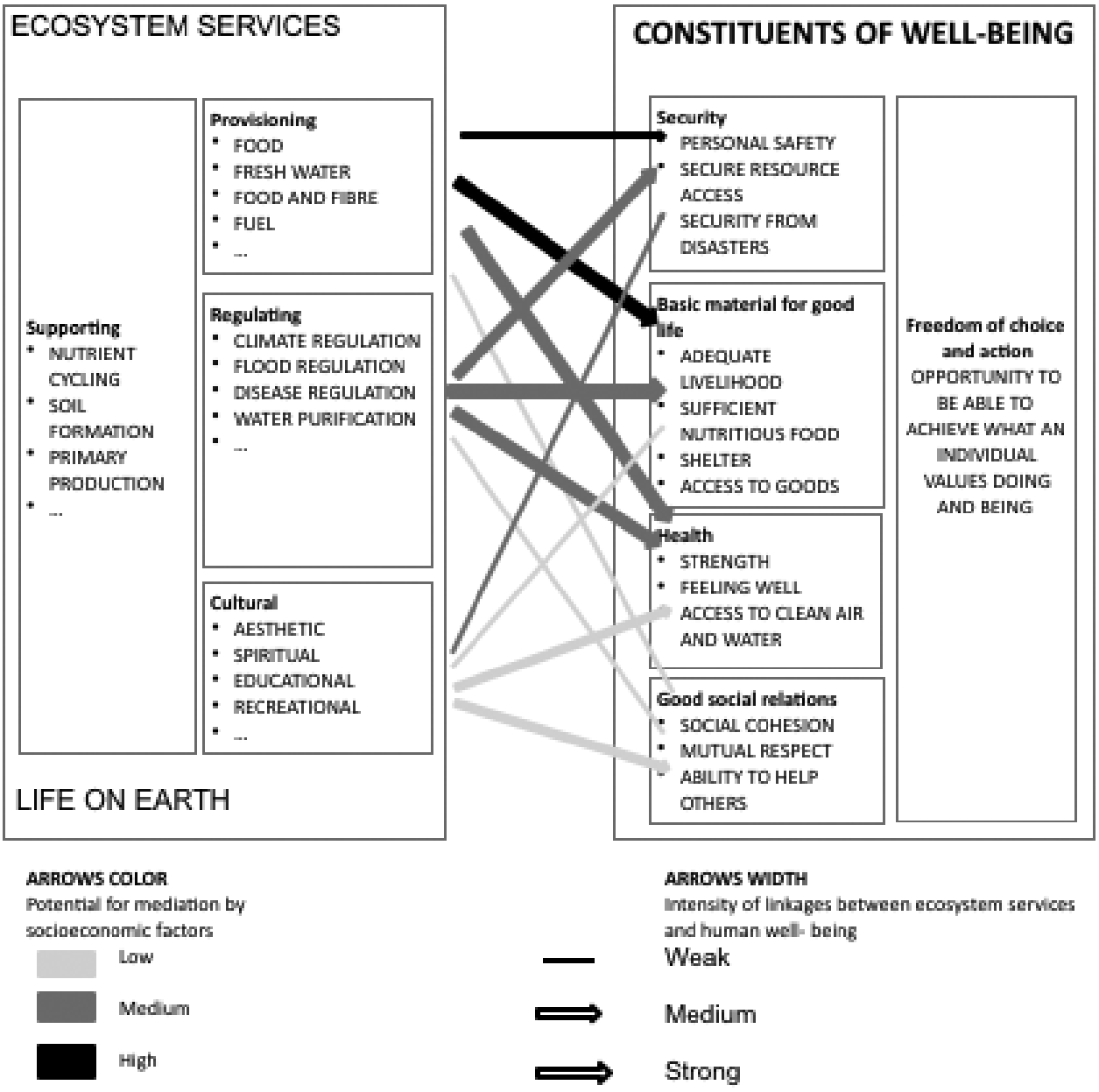
1 Since this paper was written the IUCN Human Dependence on Nature initiative has been renamed 'People in Nature'.

2 http://medical-dictionary.thefreedictionary.co/conceptual+framework

nally proposed in the MEA is conceptually different from the other categories of supporting, provisioning and regulating services. These last three categories generally relate to biophysical processes which create conditions necessary for the continuation of life on earth, on which humans directly and ultimately depend for survival. The nature and value of cultural services is interpreted in different ways by different communities, and however essential they may be for human wellbeing, cultural services are social constructs, not the product of biophysical functions and processes.

Since the publication of the MEA, a number of other reports and papers have revised the initial categories in an attempt to improve such inconsistencies in categorisation. For example, Fisher et al. (2009) suggest that classifications of ecosystem services should be fit-for-purpose and consider the social and political context within which ecosystem services are being investigated or utilised.

Figure 1: Ecosystem services and their linkages with human well-being



Source: Millennium Ecosystem Assessment (2005, p. vi)

The Common International Classification of Ecosystem Services (CICES) project (see Haines-Young and Potschin, 2011), is encouraging international review and comment in an attempt to produce a more robust and relevant categorisation. The latest version of the CICES as of 2013 is shown in Table 1a and 1b below.

Some specific examples of dependence on nature are given by Robichaud et al. (2001) for local communities living in National Biodiversity Conservation Areas in Laos, in Table 2.

Table 1a: The Common International Classification of Ecosystem Services

Table 2: The CICES Classification (V3, 2011)

Theme	Service Class	Service Group	Service Type	Sub-types	Examples and indicative benefits
Provisioning	Nutrition	Terrestrial plant and animal	Commercial cropping	eg. by crops	Cereals, vegetables, vines etc.
			Subsistence cropping	eg. by crops	Cereals, vegetables, vines etc.
			Commercial animal production	eg. by animal	Sheep, cattle for meat and dairy products
			Subsistence animal production	eg. by animal	Sheep, cattle for meat and dairy products
			Harvesting wild plants and animals for food	eg. by resource	Berries, fungi etc
		Freshwater plant and animal	Commercial fishing (wild populations)	eg. by fishery	By species
			Subsistence fishing	eg. by fishery	By species
			Aquaculture	eg. by fishery	By species
			Harvesting fresh water plants for food	eg. by resource	Water cress
		Marine plant and animal	Commercial fishing (wild populations)	eg. by fishery	Includes crustaceans
			Subsistence fishing	eg. by fishery	Includes crustaceans
			Aquaculture	eg. by fishery	Includes crustaceans
			Harvesting marine plants for food	eg. by resource	Seaweed
		Potable water	Water storage	eg. by feature	Spring, well water, river, reservoir, lake
			Water purification	eg. by habitat	Wetlands
	Materials	Biotic materials	Non-food plant fibres	eg. by resource	Timber, straw, flax
			Non-food animal fibres	eg. by resource	Skin, bone etc., guano
			Ornamental resources	eg. by resource	Bulbs, cut flowers, shells, bones and feathers etc. (Stones? Gems?)
			Genetic resources	eg. by resource	Wild species used in breeding programmes
			Medicinal resources	eg. by resource	Bio prospecting activities
		Abiotic materials	Mineral resources		Salt, aggregates, etc. (EXCLUDE subsurface assets)
	Energy	Renewable biofuels	Plant based resources	eg. by resource	Wood fuel, energy crops etc.
			Animal based resources	eg. by resource	Dung, fat, oils
		Renewable abiotic energy	Wind	eg. by resource	
			Hydro	eg. by resource	
			Solar	eg. by resource	
			Tidal	eg. by resource	
			Thermal	eg. by resource	

Table 1b: The Common International Classification of Ecosystem Services

Table 2: The CICES Classification (V3), cont.

Theme	Service Class	Service Group	Service Type	Sub-types	Examples and indicative benefits
Regulation and Maintenance	Regulation of wastes	Bioremediation	Remediation using plants	eg. by method	Phytoaccumulation, phytodegredation, phytostabilisation, rhizodegradation,
			Remediation using micro-organisms	eg. by method	In situ (Bioremediation), ex situ (composting), bioreactors
		Dilution and sequestration	Dilution	eg. by method	Wastewater treatment
			Filtration	eg. by method	Filtration of particulates and aerosols
			Sequestration and absorption	eg. by method	Sequestration of nutrients in organic sediments, removal of odours
	Flow regulation	Air flow regulation	Windbreaks, shelter belts	eg. by process	
			Ventilation	eg. by process	
		Water flow regulation	Attenuation of runoff and discharge rates	eg. by process	Woodlands, wetlands and their impact on discharge rates
			Water storage	eg. by process	Irrigation water
			Sedimentation	eg. by process	Navigation
			Attenuation of wave energy	eg. by process	Mangroves
		Mass flow regulation	Erosion protection	eg. by process	Wetlands reducing discharge peak
			Avalanche protection	eg. by process	Stabilisation of mudflows, erosion protection [reduction]
	Regulation of physical environment	Atmospheric regulation	Global climate regulation (incl. C-sequestration)	eg. by process	Atmospheric composition, hydrological cycle
			Local & Regional climate regulation	eg. by process	Modifying temperature, humidity etc.; maintenance of regional precipitation
		Water quality regulation	Water purification and oxygenation	eg. by process	Nutrient retention in buffer strips etc. and translocation of nutrients
			Cooling water	eg. by process	For power production
		Pedogenesis and soil quality regulation	Maintenance of soil fertility	eg. by process	Green mulches; n-fixing plants
			Maintenance of soil structure	eg. by process	Soil organism activity
	Regulation of biotic environment	Lifecycle maintenance & habitat protection	Pollination	eg. by process	By plants and animals
			Seed dispersal	eg. by process	By plants and animals
		Pest and disease control	Biological control mechanisms	eg. by process	By plants and animals, control of pathogens
		Gene pool protection	Maintaining nursery populations	eg. by process	Habitat refuges
Cultural	Symbolic	Aesthetic, Heritage	Landscape character	eg. by resource	Areas of outstanding natural beauty
			Cultural landscapes	eg. by resource	Sense of place
		Spiritual	Wilderness, naturalness	eg. by resource	Tranquillity, isolation
			Sacred places or species	eg. by resource	Woodland cemeteries, sky burials
	Intellectual and Experiential	Recreation and community activities	Charismatic or iconic wildlife or habitats	eg. by resource	Bird or whale watching, conservation activities, volunteering
			Prey for hunting or collecting	eg. by resource	Angling, shooting, membership of environmental groups and organisations
		Information & knowledge	Scientific	eg. by resource	Pollen record, tree ring record, genetic patterns
			Educational	eg. by resource	Subject matter for wildlife programmes and books etc.

Source: Haines-Young and Potschin (2011)

Table 2: Economic benefits of National Biodiversity Conservation Areas in Laos

BENEFIT	DESCRIPTION	EXAMPLES	LEVEL AT WHICH BENEFIT PERCEIVED			
			Village	Province	Nation	World
Protection and utilization of species	Protection of plants & animals used without killing	elephants, resin trees, bamboo shoots	***	**	**	**
	Protection of species used after killing	All hunted animals, many NTFPs	*/**	**	**	**
	Opportunities for improved breeding (higher yields or pest resistance etc.)	Teak, hybridization of domestic and wild cattle	*	*	**	***
	Retain opportunities for new uses or added economic value from species	New medicines	*	*	**	***
	Maintain web of species relationships, thus preventing "knock-on" extinctions	Pollinators, and animals that disperse tree seeds	**	*	**	***
Ecosystem services	Regulation of water supplies	Minimize drought/and floods	***	***	***	*
	Protection of soils	Prevent erosion and siltation	***	***	**	*
	Regulate local climate	PPN-Vientiane	**	**	*	0/*
	Regulate atmospheric composition	Fix CO_2 in vegetation, thus limiting climate change	0/*	*	**	***
Other development opportunities	Ecotourism	NHA, PKK	***	***	***	*
	Sustainable timber harvest	Industrial model/Village forestry model	0/***	**/**	***/*	*/*
	Hydropower	Nam Leuk, NT2	0	**	***	0/*
	Education and research	PPN, PKK	*	**	**	**

Source: Robichaud et al. (2001, p.23)

1.2 Focus of the report on livelihoods

As noted in the introduction to this paper, the aim of the HDN project is to develop a 'framework' (see definition above) that can be used to explain social and economic aspects of human dependence on nature, particularly for food and nutrition security. The framework can then be used by donors etc. to develop policies and programmes at different scales that protect and improve security as a means of poverty alleviation and livelihood protection.

Given the above, the following discussion focuses on conceptual and analytical frameworks that have been applied to direct and indirect uses of the natural environment relating to provisioning, regulating and maintenance services as shown in Table 1a and 1b above. The discussion does not consider in depth those aspects of human dependence on nature that relate to cultural services shown in Table 1b above (see Adekolaa & Mitchella, 2011).

2. CONCEPTUAL FRAMEWORKS

This section of the paper discusses some conceptual frameworks that can be, and have been, used to examine economic behaviour in relation to human use of nature.

2.1 Microeconomics[3]

Microeconomics focuses on the determination of prices, outputs, and income distribution in markets through supply and demand. It is assumed that these arrangements take place in a context where individuals and businesses seek to allocate (invest) their scarce resources of land, labour, capital, and other assets[4] in ways that will maximise the return on their investment to maximise their 'utility' or 'welfare'.

It is assumed that in theory, if fully informed about the relative level of returns from different allocations of resources, individuals and businesses will make rational decisions which maximise the returns they seek.

Of course, rational behaviour depends on a set of fundamental preconditions; in particular, that producers and consumers are perfectly informed about the relative costs and benefits of their different allocation choices, and that the market prices suppliers and consumers pay fully reflect all the direct and indirect impacts of producing and consuming the goods and services in question. In addition, government attempts to influence the price of goods and services for social objectives through taxes and subsidies, are clear to suppliers and consumers.

2.1.1 Some microeconomic concepts

Some principal concepts in microeconomics (which can be used as criteria for evaluation) include the following.

Economic efficiency

Economists are interested in the interaction of supply and demand in markets which theoretically, under a hypothetical situation of 'perfect competition', should lead to an efficient allocation of resources. Under an efficient allocation of resources no-one can be made better off without someone being made worse off.

Negative and positive externalities

Supply and consumption of resources (including natural resources) generates a range of direct and indirect benefits and costs. Whilst direct users of a resource gain direct benefits, consumption of a resource will also generate indirect costs and benefits for those who are not directly involved in the consumption of the resource. These 'third party' effects (negative and positive externalities) should be reflected in the price of the resource paid by users, otherwise resource use will be distorted and resources will be allocated inefficiently (from society's viewpoint).

For example, pollution is a result of inefficient pricing of resources, where the price paid by the consumer for using a particular resource does not cover the costs incurred by third parties from its use (e.g. health costs, costs of environmental degradation). The Polluter-Pays principle aims to incorporate the indirect costs of the use of the resource on 'innocent bystanders' in the overall cost users have to pay to consume the resource.

As well as such negative externalities, positive externalities also reflect an inefficient allocation of resources, but in this case conferring an unpaid benefit on third parties.

Market failure and public goods

Many resources, particularly relating to the natural environment, do not have an obvious market price and therefore are not allocated according to price signals. Thus the market fails to provide a particular good or service at the required level. Such resources may have the characteristic of public goods. Pure public goods are 'non-rival', in that one person's consumption of a product does not reduce the amount available to other consumers, and are 'non-excludable', since it is difficult or usually impossible to exclude any person or group from obtaining the benefits they provide. As there is generally no direct relationship between the cost

3 'Conventional' ('neo-classical') economics encompasses, but distinguishes, microeconomics and macroeconomics (see section 2.2).

4 Known as 'factors of production'.

of supply and the consumption of public goods, market prices cannot easily be used in determining their allocation.

Governments may intervene to correct the failure of the market to efficiently allocate these resources by financing their provision through public funding. The extent to which governments intervene in the market may be determined by political philosophies as well as to reduce negative externalities and generate positive externalities.

Valuation of non-market goods

Although pubic goods have no obvious market price, economists can estimate economic values for them in various ways, including estimating replacement costs, by observing peoples' behaviour, or by asking people what they are prepared to pay in some hypothetical market for the resource.[5]

Opportunity costs

Whenever a resource is used for one purpose, the user forgoes the value they would get from using it for some other purpose (i.e. its opportunity cost). In terms of economic efficiency, users would want to make sure they were using the resource for the activity which yielded its highest return.

Distributional impacts

Economists are also interested in how goods and services are distributed in the community. Governments may intervene to ensure particular social groups or regions are not disproportionately disadvantaged (or advantaged) by incurring excessive indirect costs or benefits.

In relation to the development of environmental policies, distributional impacts can be seen at a spatial scale, where use of a resource can have an impact on a different geographical location. For example, poorly managed forestry in an upstream catchment can have subsequent impacts on downstream parts of the catchment through sedimentation and eutrophication of coastal wetlands, with consequential impacts on communities dependent on these environments for their livelihoods. Economists are interested in estimating the economic implications of these biophysical impacts.

2.1.2 Microeconomic models of human dependence on nature

Researchers have used microeconomics to identify a series of different models of human dependence on nature based on different levels of trade, market development, method of exchange, welfare maximisation and allocation of scarce resources. Some models are described below.

Pure closed household economies

In closed (household) economies, goods are not traded, but are produced and consumed by the same households, i.e. a closed household economy is an economy where households are closed to trading. The production and consumption of goods is not separated, as in a society with high division of labour. The closed household economy contrasts with a barter economy, in which goods are traded against each other, and a monetary economy, in which goods are traded for money (see http://en.wikipedia.org/wiki/Closed_household_economy).

Subsistence economies

A subsistence economy is an economy which is not based on money, in which buying and selling are absent or rudimentary (though barter may occur), and which commonly provides a minimal standard of living. Subsistence economies generally only produce enough output for consumption by their members and provide little to no surplus for other investments, or capital accumulation.

For example in the subsistence agriculture sector, farmers focus on growing enough food to feed themselves and their families. The typical subsistence farm has a range of crops and animals needed by the family to feed and clothe themselves during the year. Planting decisions are made principally with a view toward what the family will need during the coming year, and secondarily toward market prices.

Most subsistence farmers also participate in trade to some degree, though usually it is for goods that are not necessary for survival, and may include sugar, iron roofing sheets, bicycles, used clothing, etc.(see http://en.wikipedia.org/wiki/Subsistence_agriculture).

Peasant economies

According to studies of peasant economies, the defining feature of peasant economies is that they are typically only partly integrated into the market economy; an economy which, in societies with a significant peasant population, is typically found to have many imperfect, incomplete or missing sectors.

Research has suggested that members of peasant economies are not simply small profit-maximising farmers, but are subject to different behaviours relating to maximisation of profits, risk aversion, drudgery aversion, and sharecropping, which have important implications in terms of producers' decisions about supply, consumption and price. Chayanov (1888-1939) was an early proponent of the im-

5 N.B. the market price paid for a good or service is not necessarily its *economic value*. (See Appendix 1)

portance of understanding peasant behaviour, arguing that peasants would work as hard as they needed in order to meet their subsistence needs, but had no incentive beyond those needs and therefore would slow and stop working once these needs were met. This principle, the consumption-labour-balance principle, implies that the peasant household will increase its work until it meets (balances) the needs (consumption) of the household. A possible implication of this view of peasant societies is that they will not develop without some external, added factor (see http://en.wikipedia.org/wiki/Peasant_economics).

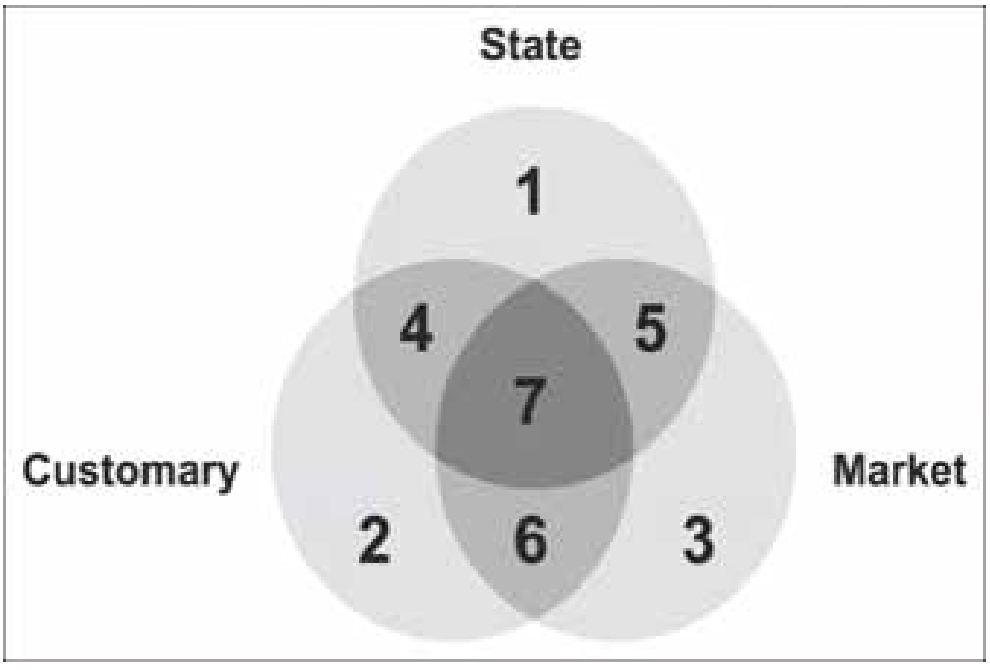
Hybrid economies

The hybrid economy model has been described by Altman (2007) in relation to Australian aboriginal communities, and comprises three sectors (circles 1, 2 and 3 in Figure 2 below). The interlinkages between these sectors (segments 4, 5, 6 and 7) are particularly important. The relative scale of the three sectors and four interlinkages vary from one context to another. Altman argues that many Indigenous Australians regularly move between these seven segments. For example, an individual might participate in wildlife harvesting for domestic use, the production of an artefact for sale, employment at a mine site or in the public sector, or be in receipt of income support from the State. Thus people are not solely reliant on welfare, or the non-market sector, or income from market engagement (adapted from Altman 2007).

An example of a hybrid economy is given in Johnson (2000) relating to the Alaskan rural economy. Johnson notes that many, or even most, Alaskan rural communities have mixed subsistence-market economies comprising cash transfers and locally harvested resources. Although households harvest substantial amounts of local foods and other natural resources for subsistence purposes, they still need cash to purchase the snow machines, boats, traps, firearms and other equipment they use for harvesting these resources. Johnson cites research which estimates that wild resources constitute 242% of the minimal protein requirements of the rural population and 35% of their calorific requirements.

Apart from food, other subsistence products are wood for heating, food smoking, housing and sled constriction, furs sold for cash and bark, plants and skins for craft sales and personal use. Johnson (p. 136) refers to a US Government report which notes that if such subsistence were not available, many Alaskan communities could become wholly dependent on government welfare payments. Such dependence may also foster increased rates of substance abuse, domestic violence, suicides, homicides, and accidents.

Figure 2: The hybrid economy framework



Source: Altman (2007 p.3)

Examples of studies that have used this type of framework

- Babul B., Muys B., Nega F., Tollens E., Nyssen J., Deckers J., & Mathijs E. (2008). 'Household livelihood strategies and forest dependence in the highlands of Tigray, Northern Ethiopia'. *Agricultural Systems*, 98(2), 147-155.
- Diepart J-C. (2010). 'Cambodian peasant's contribution to rural development: a perspective from Kampong Thom Province'. *Biotechnol. Agron. Soc. Environ.*, 2010 14(2), 321-340.
- Grey M.C., Altman J.C., Halasz N. (2005). *The Economic Value of Wild Resources to the Indigenous Community of the Wallis Lake Catchment*. http://caepr.anu.edu.au/sites/default/files/Publications/DP/2005_DP272.pdf.
- Illukpitiya P., Yanagida J. F. (2010). 'Farming vs. forests: trade-off between agriculture and the extraction of non-timber forest products'. *Ecological Economics*, 69(10), 1952-1963.
- Kamanga P., Vedeld P., & Sjaastad E (2009). 'Forest incomes and rural livelihoods in Chiradzulu District, Malawi'. *Ecological Economics,* Elsevier, 68(3), 613-624.
- Knight J., Song L. (2003). 'Chinese Peasant Choices: Migration, Rural Industry or Farming'. *Oxford Development Studies* June 2003, 31(2), 123-147.
- Pouliot M., Treue T., Darko Obiri B., Oudraougo B. (2012). 'Deforestation and limited contribution of forests to rural livelihoods in West Africa: Evidence from Burkina Faso and Ghana'. *AMBIO - A Journal of the Human Environment*, 41(7), 738-750.
- Sunderlin W., Angelsen A., Belcher B., Paul Burgers P., Nasi R., Santoso L., Wunder S. (2005). 'Livelihoods, forests, and conservation in developing countries: an overview'. *World Development* 33(9), 1383–1402.
- Wang C.; Li Y. (2007). 'Behavioral Decision of Employment for Rural Labors: Evidence from Peasant Households in Central China'. *Agricultural Economics Review*, 2007, 8(1), 22-36.

Relevance to analysis of HDN and development of an HDN framework

The above concepts and principles have been used by numerous researchers to examine a variety of socio-economic issues relating to HDN. The strengths of a microeconomic analysis framework are the underpinning principles of seeking allocations of scarce resources in ways that will maximise the utility of individuals (and thus the aggregate welfare of society). Until recently, the focus of neoclassical microeconomics on supply, demand, prices and the functioning of markets has paid little attention to the effects of economic activity on third parties, i.e. the indirect effects of resource allocation decisions on third parties or on natural assets such as the natural environment (known as negative and positive externalities).

In recent years, economists have increasingly been examining how goods and services typically without prices ('unpriced goods') can be allocated efficiently by markets in ways that avoid negative externalities such as soil erosion, overfishing, loss of biodiversity and ecosystem services, health costs and social disadvantage.[6]

By identifying obstacles to efficient allocation, such as the existence of market prices that do not reflect the full costs (including social costs) of production and use of goods and services, or the intended, or perverse, effects of government policies that distort market prices, microeconomic analysis can be a useful framework for examining the nature of, and influences on, human use and dependence on the natural environment.

2.2 Macroeconomics

Macroeconomics is concerned with the behaviour, functioning and internal interactions of economies as a whole, in contrast with microeconomics which, as noted above, is concerned with the behaviour of individuals, households, or markets. For the purposes of macroeconomics, an economy may be at the local, regional, national, or international scale.

A major distinction between microeconomic and macroeconomic analysis is that in microeconomics, allocation of resources at the individual or household level is assumed to have no effect on the functioning of the economy as a whole, i.e. other things remain as they were (*ceteris paribus*). In contrast, macroeconomic analysis considers the effects of changes that can influence inter-sectoral relationships at the economy-wide scale.

While microeconomics is concerned with efficient allocation of scarce resources for the net benefit of the community, macroeconomics uses models that explain the relationship between actors such as national income, output, consumption, unemployment, inflation, savings, investment, international trade and international finance. Aggregated

6 i.e. Under an economically efficient allocation of resources no one can be made better off without someone being made worse off.

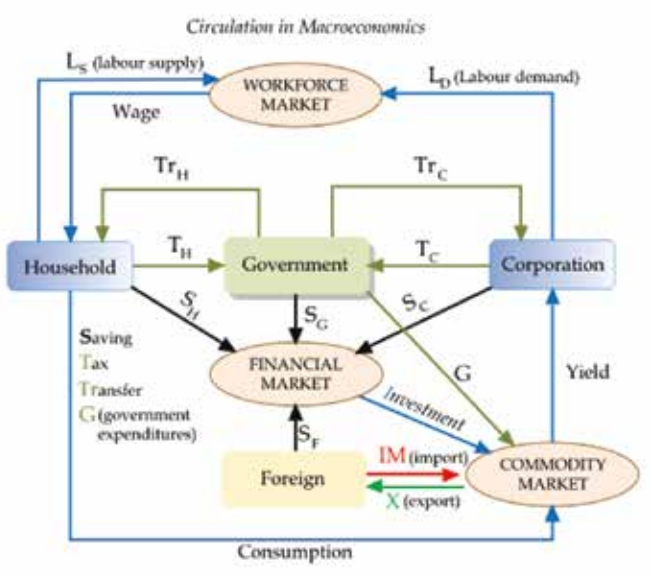
indicators such as gross domestic output and product, unemployment rates, and price indices are used to measure and explain the functioning and performance of economies.

Figure 3 below shows the theoretical relationship between different sectors and markets in a developed economy, and is based on the idea of flows (transfers) of labour, wages, taxes and expenditures between the different sectors of the economy.

Although commonly used at national or regional scales, macroeconomics can be relevant to HDN in terms of the interactions of households with other parts of the local or national economy, e.g. peasant households as providers of temporary labour to other parts of the economy, as recipients of wages from sales of surplus goods, as consumers of goods and services produced in other parts of the economy, and in some cases as recipients of government support payments (e.g. to expand the frontier of agricultural production under land settlement programmes).

An example of human dependence on nature in the context of national economies in shown in Table 3.

Figure 3: Macroeconomic explanation of economic activity



Source: https://en.wikipedia.org/wiki/File:Circulation_in_macroeconomics.svg

Examples of studies that have used this type of framework

- Campbell B.M., Jeffrey S., Kozanayi W., Luckert M., Mutamba M., & Zindi C (2002). *Household Livelihoods in Semi-Arid Regions: Options and Constraints*. CIFOR. http://www.cifor.org/online-library/browse/view-publication/publication/1099.html
- Carter M. R., Little P. D., Mogues T., Negatu W. (2006). 'Poverty Traps and Natural Disasters in Ethiopia and Honduras'. *World Development* 35(5), 835-856, 2006.
- Grosh M. and Glewe P. (2000). *Designing Household Survey Questionnaires for Developing Countries: Lessons from 15 Years of the Living Standards Measurement Study*. Volumes 1, 2, and 3. The World Bank. http://econ.worldbank.org/
- Guo Z., Zhang L., Li Y. (2010). *Increased Dependence of Humans on Ecosystem Services and Biodiversity*. http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0013113
- Natural Environment Research Council (2008). *Ecosystem Services for Poverty Alleviation: Marine & Coastal Situational Analysis*. http://www.nerc.ac.uk/research/programmes/espa/resources.asp
- Tan X. (2006). 'Environment, Governance and GDP: Discovering Their Connections'. *International Journal of Sustainable Development,* 9(4), 311-335.

Relevance to analysis of HDN and development of an HDN framework

A macroeconomic framework can be relevant to HDN, if used to examine interactions between households dependent on nature and other parts of a local or national economy. Such interactions may relate to the role of local communities in providing temporary labour to other parts of the economy, as recipients of wages from sales of surplus goods which are then spent on purchasing goods and services produced in other sectors of the economy, and in some cases, as recipients of government or other donor support payments.

Table 3: Contribution of subsistence fishing to national economies in Pacific Island Countries and Territories (as a percentage of GDP)

PICT	Catch volume [mt]	Catch value [US$]*	% GDP contribution	% of coastal fishing
American Samoa	120	478,000	0.1%	77%
CNMI	220	631,700	0.1%	49%
Cook Islands	267	1,250,000	0.6%	67%
Fiji	17,400	33,812,500	1.2%	65%
French Polynesia	2,880	13,208,276	0.2%	42%
FSM	9,800	15,732,000	6.7%	78%
Guam	70	217,000	0.0%	61%
Kiribati	13,700	28,571,429	22.5%	66%
Marshall Islands	2,800	4,312,000	2.9%	75%
Nauru	450	661,345	3.1%	69%
New Caledonia	3,500	15,770,115	0.2%	72%
Niue	140	617,647	6.2%	93%
Palau	1,250	2,511,000	1.5%	59%
Pitcairn Islands	7	36,765	n.a.	58%
PNG	30,000	35,472,973	0.6%	84%
Samoa	4,495	14,903,842	2.7%	52%
Solomon Islands	15,000	10,980,392	2.6%	82%
Tokelau	375	711,397	n.a.	100%
Tonga	2,800	6,182,178	2.4%	43%
Tuvalu	989	2,232,686	12.7%	81%
Vanuatu	2,830	5,740,385	1.1%	84%
Wallis & Futuna	840	6,333,333	3.4%	87%
Total	109,933	200,366,961	-	-
Average (country)	4,997	9,107,589	0.6%	71%

Source: cited in Ram-Bidesi et al. (2012, p.13)

2.3 Ecological economics

Ecological economics provides another conceptual framework which could be applied to analysis of human dependence on nature. Key issues in ecological economics include relationships between nature, justice, and time. Ecological economic analysis is guided by questions about intergenerational equity, irreversibility of environmental change, the social and ecological consequences of economic activity and the meaning and achievement of sustainable development (see http://en.wikipedia.org/wiki/Ecological_economics).

2.3.1 Sustainability and sustainable development

According to Gowdy (2000), a key difference between ecological economics and neo-classical economics relates to their treatment of sustainability, with neo-classical economics concerned with 'weak sustainability' and ecological economics concerned with 'strong sustainability', particularly in relation to environmental management.

Gowdy suggests that the 'weak sustainability' perspective interprets the human use of the environment as a purely economic problem, and that a loss of environmental resources can be managed by using human-made substitutes. According to Gowdy, under the weak sustainability perspective, an economy is sustainable as long as economic value (expressed as market prices), is maintained. In contrast, the strong sustainability perspective defines sustainability as maintaining essential non-replaceable, and non-substitutable environmental features, not just maintaining economic value (Gowdy 2000).

Becker (2005) has identified a set of possible sustainable development indicators using ecological, and other, concepts. These concepts include resilience (diversity, stability and adaptability), auto-sufficiency (carrying capacity, low entropy integrated systems), and collaboration (inclusivity, compatibility and continuation). Some of these concepts may be relevant to HDN, particularly resilience, as discussed below.

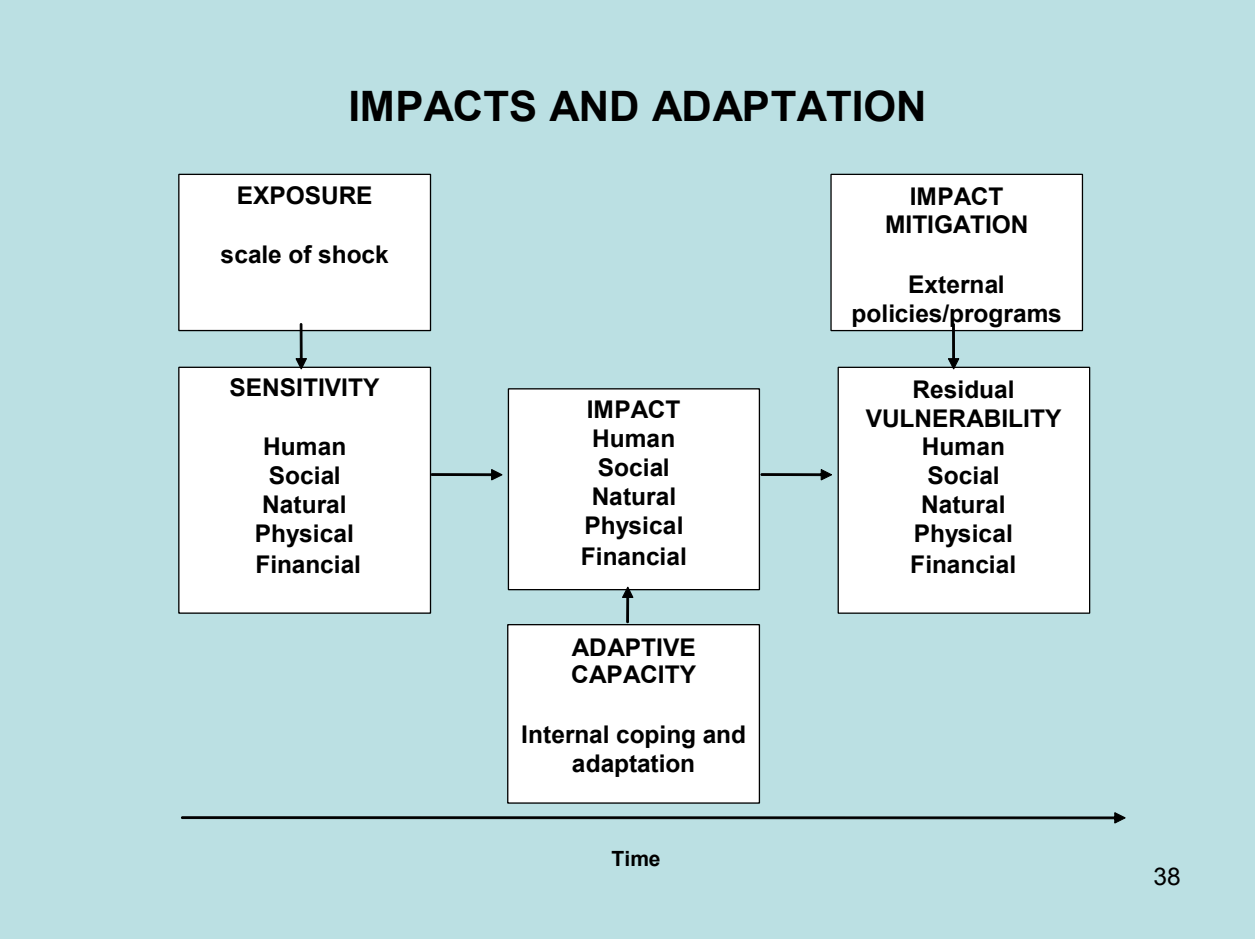
2.3.2 Socio-economic resilience

The resilience and vulnerability of a community to a change or economic shock can be seen in relation to the level of exposure to the shock, the sensitivity of the community to the change, and the community's adaptive capacity. Some factors affecting the impact of a particular shock for a community are shown in Figure 4 below.

The level of tangible and intangible assets in a community affects its sensitivity to shock, and the adaptive strategies the community can make. As shown in Figure 4, tangible and intangible community assets can be categorised as five capitals, i.e.:

- Human capital – skills, health, education of individuals
- Social capital – close social bonds that help cooperative action
- Natural capital – productivity of land and natural resources which the community depends on
- Physical capital – capital items produced by economic activity e.g. infrastructure, equipment and biological resources (crops, livestock)
- Financial capital – level, variability and diversity of income source and access to other financial resources (credit/ savings).

Figure 4: Factors influencing Socio-economic resilience



Source: Nelson et al. (2007)

Communities with greater diversity and stocks of the five capitals are likely to be less sensitive, and have greater adaptive capacity to deal with events e.g. drought, floods, and pest outbreaks. These communities have greater resources to rely on and greater flexibility to adopt different livelihood strategies under stress. The balance between the five capitals is important, and minimum levels of one capital may be necessary to make use of others.

This approach was used to identify rural communities in the Murray Darling Basin in South-east Australia which would be economically and socially vulnerable to proposed government polices to reduce water allocations to irrigated agriculture to allow increased environmental flows (Nelson et al., 2007).

Examples of studies that have used this type of framework

- Adhikari B., Di Falco S., Lovett J.C. (2004). 'Household characteristics and forest dependence: evidence from common property forest management in Nepal'. *Ecological Economics,* 48(2), 245-257.
- Derissen S, Quaas M, Baumgärtner S. (2011). 'The relationship between resilience and sustainability of ecological-economic systems'. *Ecological Economics*, 70(6), 1121-1128.
- Baumgärtner S., Derissen S., Quaas MR., & Strunz S. (2011). 'Consumer Preferences Determine Resilience of Ecological-Economic Systems'. *Ecology & Society,* 16(4), Special section 1-12.

Relevance to analysis of HDN and development of an HDN framework

Ecological economics can be used to examine the socio-economic dimensions of HDN by investigating certain aspects of the interaction between human and the natural environment in particular situations.

2.4 Driving forces-pressure-state-impact-response framework

The Driving Forces - Pressure - State - Impact - Response framework (DPSIR) can be used to map and illustrate causal and indirect interrelationships between a wide range of socio-economic, institutional, demographic, environmental, and cultural trends and influences, and potential responses to these trends and influences and their impacts.

In this sense, the framework can incorporate social, environmental, political, economic, and technological trends, impacts and outcomes. Some trends, impacts and outcomes relating to HDN in the Pacific are shown in Table 4 below.

DPSIR has most commonly been used in relation to State of the Environment Reporting (see New Zealand Ministry for the Environment, 2011) where it has been based on development of measurable indicators that can be used to assess changes in environmental quality. For example, the key components of the DPSIR framework (relating to measures of changes in coastal zone environments) have been defined as follows.

- ***Drivers:*** changes in large-scale socio-economic conditions and sectoral trends, such as large-scale changes to human population dynamics, globalisation, urbanisation, and development in the industrial sectors in the coastal zone.
- ***Pressures:*** processes and mechanisms provoking changes in the natural environment, such as coastal construction altering coastal wetlands, or the introduction of agricultural contaminants and nutrients into the coastal watershed.
- ***State:*** environmental or ecological changes as a result of the imposed pressures, generally illustrated using a set of readily determined parameters or environmental quality indicators. Examples include enhanced sedimentation in lagoons, decline in the biodiversity of salt marshes, and saline intrusion into groundwater.
- ***Impacts:*** measurable changes in social and economic benefits and values, resulting from environmental changes, such as decline in coastal fisheries due to sedimentation, decline in property values resulting from coastal erosion, and loss in agricultural income from salinisation of soils.
- ***Responses*:** changes in policy and management practices to mitigate the socio-economic impacts of environmental degradation, such as better management of wastewater treatment, and improved agricultural practices (New Zealand Ministry for the Environment, 2011).

Table 4: Trends, impacts and outcomes relating to HDN in the Pacific

Type	Examples
Social/cultural	• Demographic trends in surroundings areas • Changes in socio-cultural orders, value systems, as well as social capital, i.e. changes in networks and community values
Technological	• Changes in recreational and commercial fishing technology leading to greater efficiency and catchability • Changes to recreational technology (e.g. jet-skis) • Improved access, by either improved access roads or greater numbers of off-terrain vehicles
Economic	• Changing use-values such as an expanding recreational sector, increasing tourism (domestic and international) • Decline in commercial harvesting due to, for example, competition from imports • Changes in input prices • Changes in non-use values, i.e. existence and option values • Resource constraints, including available expertise
Environmental	• Climate change • Extreme climatic events (e.g. storms and floods) • Anthropogenic environmental factors such as point source and non-point source pollution in upstream catchments
Political/institutional	• Changes to national fisheries management and marine biodiversity policies • Changing social and economic objectives of agencies and government (e.g. ecologically sustainable development) • Unexpected legal developments • Restructuring of managerial institutions

Source: Conner (2009)

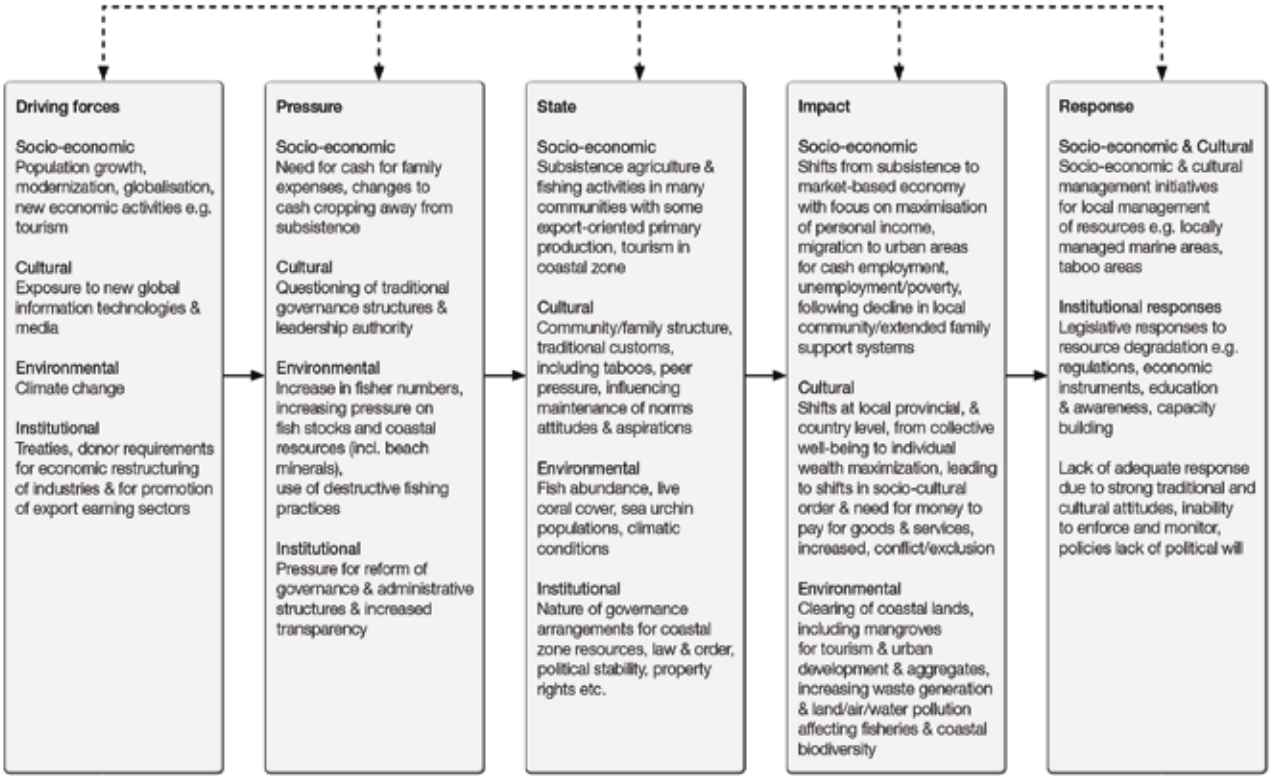
Despite its origins as a tool for reporting on changes in indicators of environmental quality, the DPSIR framework can be applied in broader contexts, as shown in Figure 5 below.

Adekolaa & Mitchella (2011) apply a DPSIR framework to an assessment of ecosystem services in the Niger delta, and also stress the importance of incorporating an assessment of the role and influence of institutions in better understanding human relationships with nature. (Institutional analysis is considered in section 2.5 below.)

Examples of studies that have used this type of framework

- Adekolaa O., & Mitchella G. (2011). 'The Niger Delta wetlands: threats to ecosystem services, their importance to dependent communities and possible management measures'. Review article. *International Journal of Biodiversity Science, Ecosystem Services & Management*, 7(1), 50–68.
- Atkins J.P. Burdon D., Elliott M., Gregory A.J. (2011). 'Management of the marine environment: Integrating ecosystem services and societal benefits with the DPSIR framework in a systems approach'. *Marine Pollution Bulletin* 62, 215–226
- Campbell B.M., Jeffrey S., Kozanayi W., Luckert M., Mutamba M., & Zindi C (2002). *Household Livelihoods in Semi-Arid Regions: Options and Constraints*. CIFOR. http://www.cifor.org/online-library/browse/view-publication/publication/1099.html
- Maxim L, Spangenberg, J, O'Connor. M. (2009). 'An analysis of risks for biodiversity under the DPSIR framework'. *Ecological Economics*, 69(1), 12-23.
- Natural Environment Research Council (2008). *Ecosystem Services for Poverty Alleviation: Marine & Coastal Situational Analysis*. http://www.nerc.ac.uk/research/programmes/espa/resources.asp
- Nelson A., Chomitz K. (2011). Effectiveness of strict versus multiple use protected areas in reducing tropical forest fires: a global analysis using matching methods. *PLOS one*, 6(8), e22722.doi10.10.1371/jounral.pone.002722.
- Peterson A., Stead S.M. (2011). Rule Breaking and Livelihood Options in Marine Protected Areas. *Environmental Conservation*, 38(3), 342-352.
- Tscherning K, Helming K., Krippner B., Sieber S., Paloma S. (2012). Does research applying the DPSIR framework support decision making? *Land Use Policy*, 29(1), 102-110.

Figure 5: Some driving forces, pressures, impacts and responses relating to the coastal zone in the Pacific



Source: Ram-Bidesi et al. (2011)

Relevance to analysis of HDN and development of an HDN framework

As noted above, Adekolaa & Mitchella (2011) used a DPSIR framework in their study of the use of, and threats to, ecosystem services in the Niger delta. They point to some of the weaknesses of DPSIR as being that the framework is too simplistic to capture more than the most basic relationships between society and the environment and that the framework also does not show interactions between drivers, or the changing inference of different drivers over time.

Despite these limitations, Adekolaa and Mitchella found that DPSIR proved to be a useful framework for structuring their analysis, and had potential as an important tool in communication with, and among, the policy community in developing societies like Nigeria. The authors also noted that (at least in their study area) understanding the role of institutions in relation to use of, and threats to ecosystem services is fundamental to the analytical process. The above suggests that some form of DPSIR framework may be a useful approach for developing an HDN framework.

2.5 Institutional analysis

HDN can also be examined from the perspective of the institutions that support and challenge its continued practice. Imperial (1999) refers to the Institutional Analysis and Development (IAD) framework developed by Ostrom and colleagues. Under this framework, institutions can be defined as regulated patterns of human action occurring over time in situations structured by rules, norms, and shared strategies, as well as by the wider physical environment. Institutional analysis is an attempt to examine a problem that a group of individuals (or organisations) face and how the rules they adopt address a problem. The design of the institution determines whether it acts for the benefits of all members of society of whether the benefits are only distributed among a few.

Ostrom (2011) suggests that institutions can be evaluated in terms of the following criteria which are similar to those listed under microeconomics (see section 2.1 above) i.e. economic efficiency, fiscal equivalence, redistributional equity, accountability, conformance to values of local actors and sustainability.

In assessing the potential application of the IAD framework to ecosystem-based approaches to natural resource man-

agement, Imperial notes that the framework also recognises the structure of pre-existing institutional arrangements, the role of culture, and the nature of the physical and biological setting can all affect the development and implementation of ecosystem-based management programmes (Imperial, 1999). These factors are also likely to be key influences on the nature of human use and dependence on ecosystem services for livelihoods, and so IAD may be a useful conceptual framework for examining certain dimensions of HDN, perhaps as part of a DPSIR framework.

Examples of studies that have used this type of framework

- Adekolaa O., & Mitchella G. (2011). 'The Niger Delta wetlands: threats to ecosystem services, their importance to dependent communities and possible management measures'. Review article. *International Journal of Biodiversity Science, Ecosystem Services & Management, 7*(1), 50–68.
- Chhatre A., & Agrawal A. (2009). 'Synergies and Trade-offs between Carbon Storage and Livelihood Benefits from Forest Commons'. *Proceedings of the National Academy of Sciences,* 106, 17667-17670.
- Natural Environment Research Council (2008). *Ecosystem Services for Poverty Alleviation: Marine & Coastal Situational Analysis*. http://www.nerc.ac.uk/research/programmes/espa/resources.asp
- Imperial M.T. (1999). 'Institutional Analysis and Ecosystem-Based Management: the Institutional Analysis and Development Framework'. *Environmental Management*, 25(4), 449-465.
- Martin R. N., Thorsten T. (2012). 'Hunting for benefits of joint forest management in the eastern afromontane biodiversity hotspot: effects on bushmeat hunters and wildlife in the Udzungwa Mountains'. *World Development*, 40(6), 1224–1239.
- Persha L., Agrawal A., Chhatre A. (2011). 'Social and ecological synergy: local rulemaking, forest livelihoods, and biodiversity conservation'. *Science* 331(6024), 1606-1608.
- Rounsevell M. D. A., Dawson T. P, Harrison P. A. (2010). 'A conceptual framework to assess the effects of environmental change on ecosystem services'. *Biodiversity & Conservation*, 19(10), 2823-2842.
- UNDP, UNEP, The World Bank, World Resources Institute (2005). World Resources 2005 – *The Wealth of the Poor: Managing ecosystems to fight poverty*. http://www.wri.org/publication/world-resources-2005-wealth-poor-managing-ecosystems-fight-poverty

Relevance to analysis of HDN and development of an HDN framework

Researchers are increasingly interested in examining the role of institutions in influencing socio-economic aspects of human use of natural resources and other environmental assets, and in particular the causes and consequences of institutional failure (see Lal and Holland, 2010):

"Institutional failure occurs where inappropriate or incompatible rules and regulations create incentives to over use or degrade resources. It may reflect both formal government failure and informal or traditional-style management failure. The failure of formal rules and regulations to address resource management issues is commonly termed 'government failure'. This is most commonly manifested in:

- an inappropriate development focus;
- a piecemeal and sectoral approach to resource management; and
- dictatorial policies.

The reasons for government failure could be a government's past attitudes; a focus on just economic development without also addressing the sustainability issues; the compartmentalisation of issues along sectoral lines; institutional design did not reflect ecological considerations; and/ or incomplete information" (Lal and Holland 2010, p57).

It is suggested that institutional analysis can provide some valuable insights into factors that may affect sustainable use of ecosystems, and in contrast, identify aspects of institutional failure that influence unsustainable practices such as overfishing, deforestation, loss of biodiversity and habitats and other activities that affect the ability of communities to derive livelihood security from their use of the natural environment.

It is suggested that institutional analysis could provide highly useful concepts and principles to help build an HDN framework if developed in conjunction with a broader conceptual framework such as DPSIR (see section 2.5 above).

3. TOOLS AND METHODOLOGIES

This section of the report considers tools and methodologies that can be used to explore socio-economic values associated with HDN.

3.1 Valuation approaches

Under neo-classical microeconomic approaches, it is assumed that goods will be allocated efficiently through the interaction of supply and demand in markets. In practice, of course, numerous economic, physical, institutional, cultural

and other factors distort this interaction and prevent this efficient allocation. One key area in which markets fail to allocate resources efficiently is in the case of goods and services which for various reasons have no market price, or have prices which do not reflect the actual impacts on environmental quality and human health caused by their production and use. Environmental and resource economists are interested in finding ways in which goods and services without correct prices ('unpriced goods') can be valued so they can be traded in markets. The 'Total Economic Value' classification described below is one attempt to define the different types of value of goods and services associated with the natural environment which commonly do not have specific market prices.

3.1.1 Total Economic Value

Under the Total Economic Value (TEV) classification values associated with human use of the natural environment are typically separated into 'use values', 'indirect use values' and 'non-use values', as shown in Figure 6 below.

Direct use values

According to the classification in Figure 6, goods and services that are used directly for consumption, as opposed to being inputs into production processes where they are transformed into other products, are regarded as having direct use values. Uses of these goods and services can be extractive or non-extractive. Examples of goods and services with direct (extractive) use values include forest products, fisheries, crops and livestock, bushmeat, genetic material and medical plants. Examples of non-extractive direct use values include nature-based recreational experiences, research, and education (see Figure 8 below).

Indirect use values

This category of values concerns functions and services enjoyed indirectly, with these goods and services generally providing an input into another activity which has economic value. Examples of indirect use values include shoreline and storm protection, climate regulation, crop pollination, flood mitigation, mangrove habitats acting as nurseries for commercially valuable fish species, carbon sequestration, and sediment and nutrient capture.

Non-use values

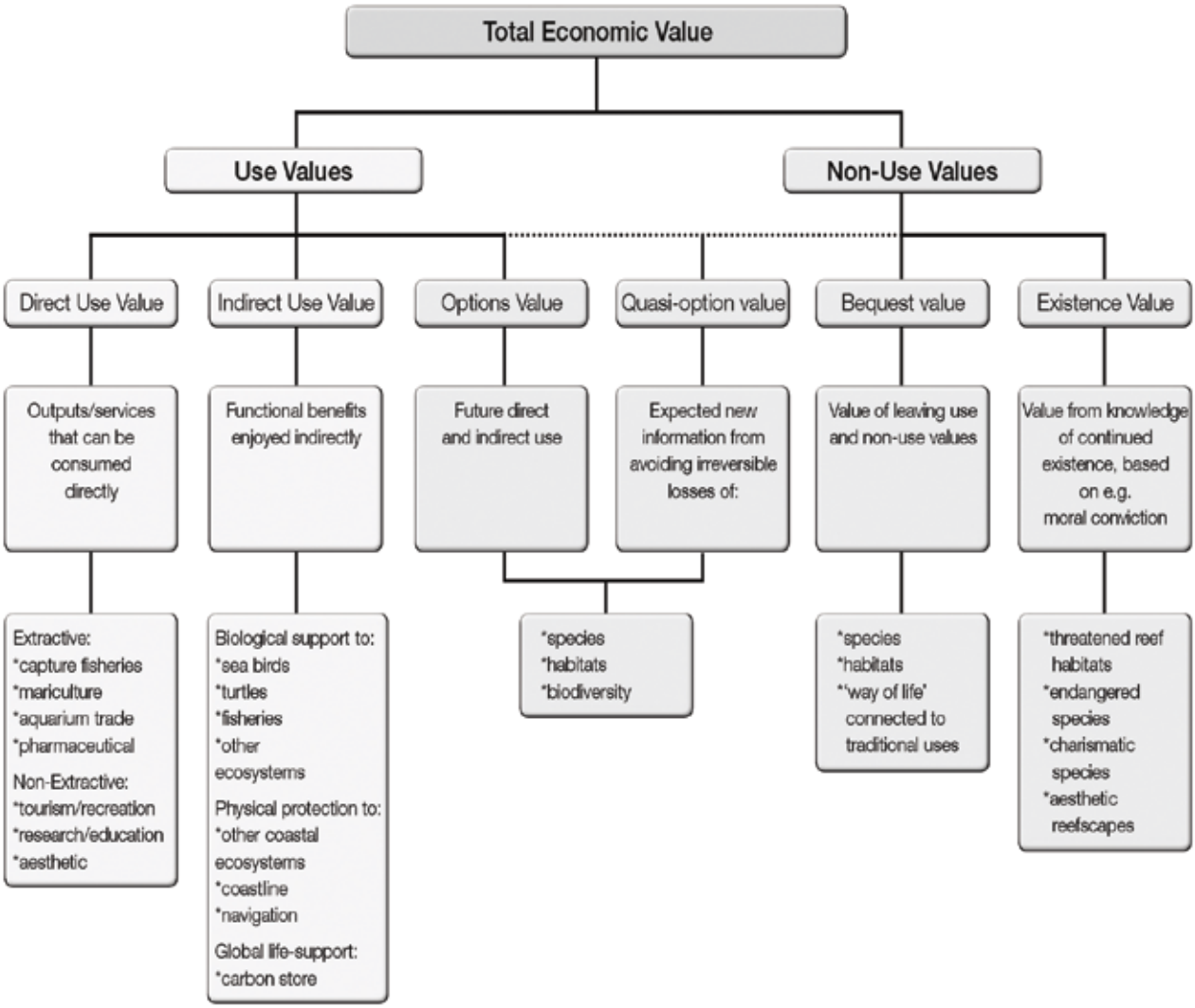
Non-use values are rather harder to define, and even distinguish as different values. Types of non-use values include:

Option value: the benefit placed on the potential future ability to use a resource even though it is not currently used and the likelihood of future use is very low. Future use may include future use by existing individuals and future generations. One example of an option value is the value to coastal communities in parts of the Pacific from creation of *tabu* areas (temporary no-take coastal zones to allow fish stocks to recover from overfishing).

Bequest value: the value attributed to maintaining something for the benefit of future generations, for example the value to indigenous Australian communities of knowing a particular cultural landscape is protected so that future generations can maintain cultural traditions associated with the land. N.B. some researchers suggest that option value and bequest value are not non-use values, but deferred use values (hence the dotted line between 'use value' and 'option value' and 'bequest value' in Figure 6 below).

Existence value: the value attributed to the satisfaction individuals get from knowing certain things exist for economic, moral, ethical or other reasons, for example, the value obtained from knowing that a rare species or ecosystem is being protected in its own right (such as the protection of whales in international whale sanctuaries).

Figure 6: Total economic value framework



Cited in Ram-Bidesi et al. (2011)

Several different techniques have been used to estimate direct, indirect and non-use values. i.e.

- market-based techniques
- revealed preference techniques
- stated preference techniques; and
- benefit transfer.

These techniques are shown in Table 5 below.

Examples of studies using some of these techniques are given in Appendix 2.

On the basis of Figure 6 above, the following section provides some examples of studies of direct use, indirect use, and non-use values associated with human dependence on nature, using some of the above valuation techniques.

Table 6 shows some values of ecosystem goods and services associated with UK marine biodiversity based on different valuation techniques.

Table 5: Valuation Techniques

Valuation Technique	Purpose
Market-based techniques	
Estimation of market price	Identify actual value of environmental goods & services & estimate private costs/ benefits
Estimation of Contribution to Production	Identify actual value of environmental goods & services as inputs into production, and estimate private costs and benefits
Estimation of Avoided costs of replacement or damage avoidance	Estimate costs of alternative sources of services normally provided by natural environments or costs and benefits of protecting environmental goods and services
Revealed preference techniques	
Hedonic Pricing	Reveal preferences of individuals attributes, based on their behaviour
Travel Cost Method	Estimate value of benefits resulting from recreational experiences in natural environments esp. protected areas
Stated preference techniques	
Contingent Valuation	Determine individual's hypothetical valuation of environmental goods and services
Choice Modelling	Determine individual's hypothetical valuation of specific environmental attributes
Benefit(s) transfer	
Process of taking information about economic values (benefits and/ or costs) from one situation & applying it to another situation	Reliability depends on similarity between characteristics of the two situations re: • their physical characteristics; • the institutional setting; • the policy environments; • their stages of economic development; & • supply & demand conditions.

Relevance to analysis of HDN and development of an HDN framework

Many studies have attempted to carry out 'total economic valuations' to estimate the direct, indirect and non-use values associated with particular ecosystems or environments (e.g. coastal wetlands). While these studies are interesting in their own right (though often flawed through double counting and lack of understanding of the conceptual differences between the different valuation techniques used), they are of limited use in policy development. Economists are interested in the incremental change between one situation and another that can be attributed to a particular policy, programme, development or 'shock' compared to the situation that would exist in the absence of such action ('the counterfactual'). I.e. the point is to assess changes in values, and costs and benefits between a base case and an action, not the total values, costs and benefits of an action.

Thus techniques for the valuation of human use of ecosystem services need to be used in the context of methodologies for estimating the impacts of certain actions on a 'Business-as-usual' situation. The following sections of this paper describe approaches that are used to estimate the socio-economic impacts of changes to a particular situation as the result of a specified programme, policy or other action.

Table 6: Estimated value of goods and services provided by UK marine biodiversity (based on different valuation methods)

Good/Service	Definition	Monetary value (per annum, UK £ 2004)	Method	Under / Over estimate	Link to biodiversity, low (1)–high (5)
Food provision	Plants and animals taken from the marine environment for human consumption	£513 million	Market	Under estimate	3
Raw materials	The extraction of marine organisms for all purposes, except human consumption	£81.5 million	Market	Under estimate	3
Leisure and recreation	The refreshment and stimulation of the human body and mind through the perusal and engagement with, living marine organisms in their natural environment	£11.77 billion*	Market	Over estimate	3
Resilience and resistance	The extent to which ecosystems can absorb recurrent natural and human perturbations and continue to regenerate without slowly degrading or unexpectedly flipping to alternate states (Hughes *et al.* 2005)	Valuation data not available	Valuation data not available	Valuation data not available	5
Nutrient cycling	The storage, cycling and maintenance of availability of nutrients mediated by living marine organism	£800 - £2320 billion**	Replacement	Use with caution	4
Gas and climate regulation	The balance and maintenance of the chemical composition of the atmosphere and oceans by marine living organisms	£0.4 - £8.47 billion	Avoidance	Under estimate	5
Bioremediation of waste	Removal of pollutants through storage, dilution, transformation and burial	Valuation data not available	Valuation data not available	Valuation data not available	5
Biologically mediated habitat	Habitat which is provided by living marine organisms	Valuation data not available	Valuation data not available	Valuation data not available	5
Disturbance prevention and alleviation	The dampening of environmental disturbances by biogenic structures	£0.3billion***	Avoidance	Under estimate	4
Cultural heritage and identity	The cultural value associated with the marine environment e.g. for religion, folk lore, painting, cultural and spiritual traditions	Valuation data not available	Valuation data not available	Valuation data not available	3
Cognitive values	Cognitive development, including education and research, resulting from marine organisms	£317 million*	Market	Over estimate	4
Option use value	Currently unknown potential future uses of the marine environment	Valuation data not available	Valuation data not available	Valuation data not available	5
Non-Use values – bequest and existence	Value which we derive from marine organisms without using them	£0.5 – 1.1 billion	Contingent valuation	Under estimate	5

** Based on 2002 value. ** Cost of treating UK water once not per annum. *** In addition to £17-32 billion capital costs*
Source: Beaumont et al. (2006)

3.2 Cost-benefit analysis

Cost-benefit analysis (CBA) is a systematic process for estimating and comparing the socio-economic benefits and costs of a project, decision, or government policy. Although CBA is commonly used in business to compare the direct financial costs and benefits of projects, social cost-benefit analysis is the appropriate technique for examining the socio-economic impacts on society of programmes, policies, and development projects.

Social CBA commonly examines the direct and indirect impacts (positive and negative external effects, or externalities) of programmes, policies developments etc. on business, government, and the wider community over time. CBA can be carried out before, during, or after, the activity in question.

It is important to note that CBA considers the incremental changes associated with the policy or programme in question compared to a base case representing the situation without the policy or programme etc. (the counterfactual). It is a common mistake by users of CBA to assume that all changes occurring in a particular situation are the result of the programme or policy in question, rather than the incremental changes that are actually attributable to the development etc. For example, the establishment of no-take marine protected areas (MPAs) in coastal zones have been blamed for causing a decline in coastal fishing activity; however proper analysis of the base case may show that a decline in catch was due to rising fuel prices, climate change, cheap imports etc., which would have occurred irrespective of the presence of the MPA.

CBA involves estimating the total direct and indirect costs and benefits attributable to the programme, project etc. in question (including estimates derived from the valuation techniques described above) for each year of the project. The stream of costs and benefits over the life of the project is then summed and discounted at a specified discount rate to give its value in today's prices, and discounted benefits

subtracted from discounted costs to give a net economic benefit or net cost. Economists are interested in the ratio of total discounted costs to benefits, and the value of the future stream of benefits and costs in today's prices (the net present value).[7]

Some examples of Pacific studies using CBA are given in Table 7.

Table 7: Selected Pacific studies using cost-benefit analysis

Theme	Costs	Comment	Source
Habitat destruction (coastal protection)	US$ 88-373 million	Building & maintaining seawalls; Majuro Atoll, Marshall Island over 25 years	McKenzie et al. 2005
Overfishing (subsistence)	US$ 66.6 million	Importing protein equivalent for subsistence communities from 5 PICs; annually	World Bank 2000
Pollution (watershed, liquid and solid waste)	US$ 11.3 million	Solid waste pollution Palau; watershed pollution in Cook Islands; solid & liquid waste in Tonga; liquid waste in Tuvalu; annually	(Hajkowicz, Tellames et al. 2005; Hajkowicz 2006; Lal, Saloa et al. 2006; Lal and Takau 2006)
Pollution (Oil spills)	up to several hundred million US$	Indicative; total costs	(De Poorter, Darby et al. 2009)
Climate change (economic development)	ca. US$ 7 billion	Melanesia and Polynesia; in late 1990s value over 20 years	Hoegh-Guldberg et al. 2000
Climate change (natural disasters)	US$ 2.8 billion	Costs of natural disasters during 1990s	Bettencourt et al. 2006
Climate change (Coral bleaching)	US$ 7.6 billion	NPV over 50 years at 3% discount rate	Cesar et al. 2003
Climate change (Mangrove loss)	US$25-470 million	In Melanesia, NPV	Lal et al. 2009

Adapted from Seidel & Lal (2010)

Examples of studies using this type of analysis

- Birol E., Koundouri P., Kountouris Y. (2010). 'Assessing the Economic Viability of Alternative Water Resources in Water-Scarce Regions: Combining Economic Valuation, Cost-Benefit Analysis and Discounting'. *Ecological Economics*, 69(4), 839-847.
- Hoang M.H., Do, T.H., P M.T., van Noordwijk M., Minang P. A. (2013). 'Benefit distribution across scales to reduce emissions from deforestation and forest degradation (REDD+) in Vietnam'. *Land Use Policy*, 31, 48-60.
- Wegner G. & Pascual U. (2011). 'Cost-benefit analysis in the context of ecosystem services for human well-being: A multidisciplinary critique'. *Global Environmental Change Part A: Human & Policy Dimensions*, 21(2), 492-504.
- Zheng W., Shi H., Chen S., Zhu M. (2009). Benefit and cost analysis of mariculture based on ecosystem services. *Ecological Economics*, 68(6), 1626-1632.

Relevance to analysis of HDN and development of an HDN framework

Social CBA provides a theoretically-based, consistent, approach for identifying the incremental direct and indirect impacts of particular programmes, policies and developments on businesses, government and the wider

7 Another measure, the Internal Rate of Return, has not been mentioned here.

community over time compared to a base case. CBA can identify distributional impacts on groups as well as society as a whole, including environmental and health damage costs. The concepts and principles underlying social CBA can make a useful contribution to development of an HDN framework; this contribution would be enhanced through including explicit consideration of social dimensions of HDN, e.g. impacts on gender, social justice and intergenerational equity.

3.3 Cost-effectiveness analysis

Cost-effectiveness analysis (CEA) is a form of economic analysis that compares the relative costs and outcomes (effects) of two or more courses of action. Cost-effectiveness analysis is distinct from cost-benefit analysis. CEA assumes that benefits are known and common to all options being considered, thus distinctions between options are made on the basis of costs alone, unlike in CBA where total costs and total benefits over the lifetime of relevant options are subtracted to show net benefits or net costs.

Examples of studies that have used this type of analysis

- Gauvin C., Uchida E., Rozelle S., Jintao X., Jinyan Z. (2010). 'Cost-Effectiveness of Payments for Ecosystem Services with Dual Goals of Environment and Poverty Alleviation'. *Environmental Management*, 45(3), 488-501.
- Jinda R., Kerr J. M., Ferraro P. J., & Swallow B. M. (2013). 'Social dimensions of procurement auctions for environmental service contracts: Evaluating trade-offs between cost-effectiveness and participation by the poor in rural Tanzania'. *Land Use Policy,* 31, 71-80.
- Narloch U., Pascual U., Drucker A. (2 011). 'Cost-effectiveness targeting under multiple conservation goals and equity considerations in the Andes'. *Environmental Conservation,* 38(4), 417-425.

Relevance to analysis of HDN and development of an HDN framework

Cost-effectiveness analysis may be applicable in HDN in limited situations where there is consensus that a project, programme etc. should proceed, and the only question is which way to achieve a pre-determined outcome.

Care would need to be taken to ensure that the consensus to proceed with the project etc. in question actually represented the views of those likely to be affected by the project. It is possible that a particular party could impose their preferences on another group by claiming that the benefits of the project were self-evident and did not need to be assessed (as would occur under a social cost-benefit analysis).

3.4 Multi-criteria analysis (MCA)

MCA provides a tool for ranking options in terms of their scores against a set of discrete economic, social environmental, biophysical and other selected criteria, based on a matrix of columns (alternative options being considered) and rows (individual criteria being used to assess the relative performance of the options). Subjective weights can be applied to the criteria in the analysis to reflect their relative importance to different groups of stakeholders. Researchers score the performance of the options being considered against the selected criteria and derive total weighted scores for each option. Depending on the criteria in question, scores can be cardinal or ordinal, and expressed in different units. Different combinations of weightings (including equal weightings) can be used to assess the sensitivity of the results obtained.

MCA can be used to identify a single, most-preferred option, rank options, shortlist a limited number of options for subsequent detailed appraisal through other frameworks such as cost-benefit analysis, distinguish acceptable from unacceptable options, and combine different options based on relative strengths (DTLR, 2000: 25):

An example of a simple MCA matrix with four options and four criteria is given in Table 8 below.

An MCA matrix may consist of criteria that can be scored objectively, subjectively, or both. However the process of deciding weights to attach to criteria is generally a subjective one.

The simplest forms of MCA are overtly subjective, and can be used in community consultation and stakeholder engagement processes to discuss the favourable and unfavourable aspects of proposed activities, and to examine the effects of different weightings (e.g. reflecting different stakeholder values) on the performance of the different options being considered.

Table 8: A simple MCA matrix

CRITERIA	Weighting (e.g. ordinal)	Option 1	Option 2	Option 3	Option 4	Sum of weighted scores for criterion
A		Raw score x weight= weighted score				
B						
C						
D						
Total score for option						

Argyrous (undated) has identified a number of strengths and weaknesses of MCA, including most of the following. Some strengths are that the MCA approach is open and explicit, and can incorporate a diverse range of information which can be communicated to stakeholders. MCA can provide an audit trail, especially in situations where decision-making is required to follow rules and to be justified in explicit terms. MCA is flexible along many dimensions: and can offer a choice of options, criteria, and weightings which can be chosen by different parties. Weaknesses of MCA include its lack of methodological rigour, its subjectivity, and potential difficulties in deriving information in a way that reflects public values rather than sectoral interests.

Examples of studies that have used this type of analysis

- Andalecio M. (2010). 'Multi-criteria decision models for management of tropical coastal fisheries. A review'. *Agronomy For Sustainable Development* (EDP Sciences), 30(3), 557-580.
- Antunes P, Karadzic V, Santos R, Beça P, Osann A. (2011). 'Participatory multi-criteria analysis of irrigation management alternatives: the case of the Caia irrigation district, Portugal'. *International Journal Of Agricultural Sustainability*, 9(2), 334-349.
- Curtis I. (2004). 'Valuing ecosystem goods and services: a new approach using a surrogate market and the combination of a multiple criteria analysis and a Delphi panel to assign weights to the attributes'. *Ecological Economics*, 50(3/4), 163-194.

Relevance to analysis of HDN and development of an HDN framework

MCA has mostly been used as a technique for exploring social values, rather than as part of economic analyses. If used as part of a local community engagement process, it may have value in giving local communities opportunities to express their attitudes and perceptions towards policies and programmes intended to safeguard and enhance local livelihood security, and thus give communities a voice in decisions made by other parties that will that affect them.

3.5 Life Cycle assessment

Life-cycle assessment (LCA) is a method of analysing the environmental impacts of a process, product, or activity along its life cycle, for example from 'cradle to the grave'. The LCA approach forms the basis for a range of 'footprint' assessments including 'carbon footprinting'.

Ecologically-based LCA, considers a much broader range of ecological impacts than 'conventional' LCA, and was designed to provide a guide to the management of human activities by highlighting the direct and indirect impacts on ecological resources and surrounding ecosystems. It quantitatively takes into account regulating and supporting services during the life cycle of economic goods and products. In this approach, services are categorised in four main groups: supporting, regulating, provisioning, and cultural services.

Examples of studies that have used this type of analysis

- Yi Z., Singh S., Bakshi R. (2010a). 'Accounting for Ecosystem Services in Life Cycle Assessment, Part I: A Critical Review'. *Environmental Science & Technology*, 44(7), 2232-2242.
- Yi Z., Baral A., Bakshi B. (2010b). 'Accounting for Ecosystem Services in Life Cycle Assessment. Part II: Toward an Ecologically Based LCA'. *Environmental*

Science & Technology, 44(7), 2624-2631.

- Ukidwe N, Bakshi B. (2005). 'Flow of Natural versus Economic Capital in Industrial Supply Networks and Its Implications to Sustainability'. *Environmental Science & Technology*, 39(24), 9759-69.

Relevance to analysis of HDN and development of an HDN framework

LCA, or Ecologically-based LCA, might be useful in assessing the sustainability of the relative impacts of different systems of HDN, but would need to incorporate some method of estimating the costs and benefits for local communities of different ways of managing the ecosystem services they depend on.

3.6 Bayesian Decision Networks

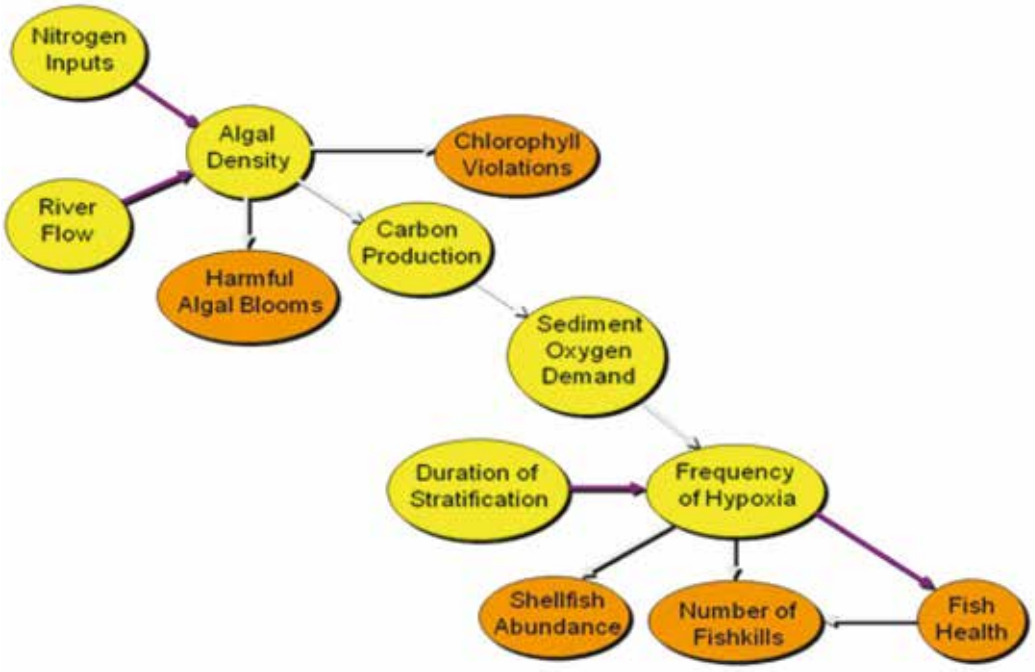
Bayesian networks are based on a series of variables joined by causal links. The network is based on nodes (states or variables) which are connected in terms of the probability of a change in the state of node 1 of x amount leading to a change in node 2 of y amount, and a change in node 3 of an amount of z, and so on. Very large networks of interconnected nodes can be built up. Probabilities of change in one node as a result of a change in another connected node are determined on the basis of proven cause-effect or dose-response relationships, and are clearly articulated in the model description.

Once the system of interlinked nodes linked by probabilities has been developed, the user can run scenarios of different policy or development options to gauge their impact on specific nodes.

Uncertainty in the relationship between each node can be explicitly represented, allowing the user to make a judgement on the reliability of the model predictions. According to Barton et al. (2012) Bayesian Decision Networks (BDNs) can efficiently incorporate social, economic and ecological values within the modelling framework because the approach lends itself to the easy incorporation of both qualitative and quantitative data. When objective data is not available, expert and local knowledge can be utilised. As new information becomes available, the BDN can be readily updated.

The example shown in Figure 7 below provides a graphical representation of the relationship between levels of nitrogen and fish health for an estuary in North Carolina, USA. This relationship is based on the probability of a change in one node (e.g. river flow) on another node (e.g. algal density) and subsequently on other nodes of interest to agencies concerned with the ecological health of the estuary in question.

Figure 7: A Simple Bayesian Network



Source: http://kreckhow.blogspot.com.au/2013/07/bayesian-probability-network-models.html

Examples of studies that have used this type of analysis

- Barton D.N, Kuikka S., Varis O., Uusitalo L., Henriksen H.J. , Borsuk M., de la Hera A., Farmani R., Johnson S. & Linnell J.D.C. (2012). 'Bayesian Networks in Environmental and Resource Management'. *Integrated Environmental Assessment and Management*, 8(3), 418–429.
- Dam A., Kipkemboi J., Rahman M.; Gettel G. (2013). *Linking Hydrology, '*Ecosystem Function, and Livelihood Outcomes in African Papyrus Wetlands Using a Bayesian Network Model'. *Wetlands,* 33(3), 381-397.
- Letcher R., Merritt W., Ticehurst J. (2006). *Coastal lakes sustainability assessments – Merimbula lake and back lagoon: adaptation of Bayesian decision network support tool.* Client report 2006/02. NSW Department of Environment and Conservation.

Relevance to analysis of HDN and development of an HDN framework

BDN can be used to qualitatively map and explain linkages, interactions and consequential relationships between a number of factors, and can help to show the complexity of linkages between a range of different variables. In the context of HDN, this can be very useful in examining the downstream socio-economic and environmental impacts of particular land use actions (e.g. the impact of logging in upper catchments on quality of downstream seagrass habitats). However, building Bayesian (probability) networks and populating the networks with robust data is complex and time consuming, and not a practical consideration for development of an easily usable and practicable HDN framework.

3.7 Regional economic impact assessment

Human dependence on nature can also be considered through the use of economic impact analysis.

Economic impact analysis is concerned with the economic relationships between businesses in an economy (whether it is a local, national or international economy). Economic impact analysis investigates how businesses in an economy interact with other businesses, workers, landowners, financial institutions and government to obtain the inputs they need to produce the goods and services they supply to consumers.

One type of economic impact analysis, input-output analysis, has been used to examine the direct and flow-on impacts (i.e. the multiplier effects) of developments such as mines, tourist resorts, casinos, and national parks on the level of business turnover, value-adding, household income and employment on local-scale economies.

Input-output analysis is based on the concept of firms in a local economy trading with each other to purchase inputs. The more diverse an economy, the greater the level of inter-firm trading. Inter-firm trading generates flow-on effects. These flow-on effects are categorised as 'production-induced' effects and measure the increased economic activity associated with inter-firm trading. For example, the establishment and ongoing management of a national park generates expenditure on capital works and park management services, and attracts visitors who generate demand for accommodation, meals, handicrafts, and entertainment. These services in turn encourage demand for building supplies, wholesale food supplies, guided tours and so on.

Businesses also employ labour and make payments to households. These households then purchase goods and services, and so generate a stream of 'consumption-induced' effects which, when added to the production-induced effects, provide values for the multipliers (total flow-on effects) used in input-output analysis (National Parks and Wildlife Service, 2001). If inputs or labour are not available locally and have to be imported, money leaks from the local economy. These effects are shown in Figure 8 below.

Instead of measuring flows of money, input-output analysis can be used to measure flows of other resources such as energy, or water in an economy or other semi-closed system.

Examples of studies that have used this type of analysis

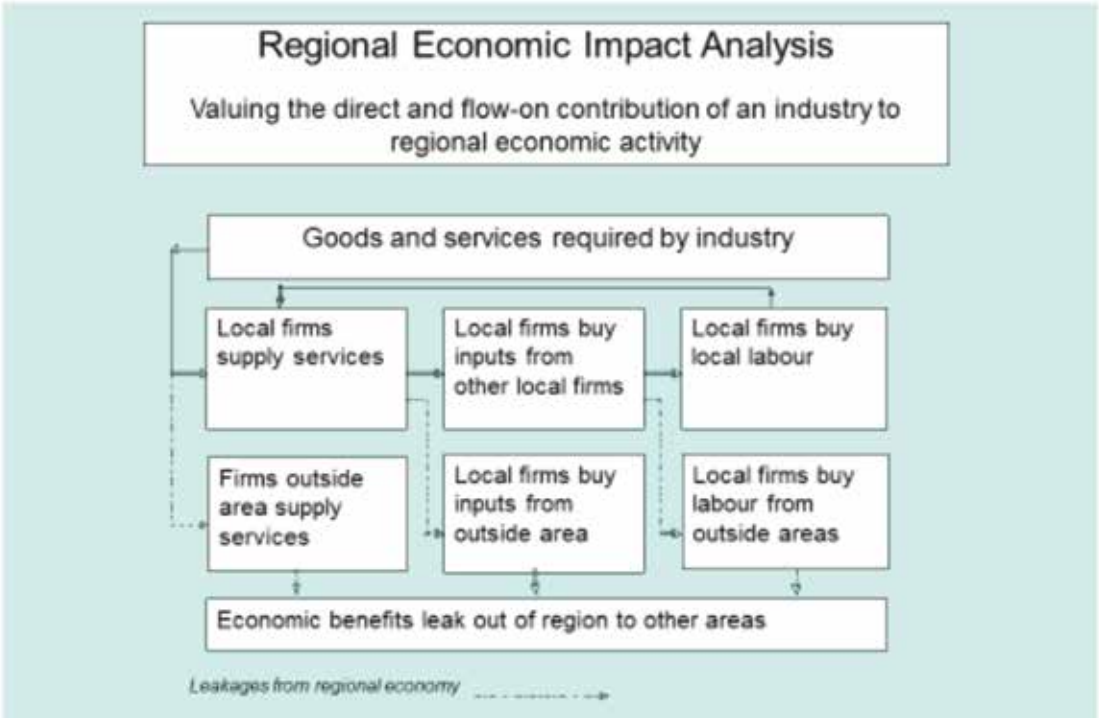
- Carter M. R., Little P.D., Mogues T., Negatu W. (2006). 'Poverty traps and natural disasters in Ethiopia and Honduras'. *World Development*, 35(5), 835-856.
- Dewi, S., Belcher, B., Puntodewo A (2004). 'Village economic opportunity, forest dependence, and rural livelihoods in east Kalimantan, Indonesia'. *World Development,* 33(9), 1419-1434.
- Milne S. (1991). 'The Economic Impact of Tourism in Kiribati'. *Pacific Studies*, 14(2), 53-70.

Relevance to analysis of HDN and development of an HDN framework

Input-output studies of e.g. national parks have proved popular with environmentalists as they can show that spending on environmental conservation can create direct and indirect (flow-on) effects in rural areas where alternative economic opportunities may be limited.

Development of comprehensive input-output tables and

Figure 8: Direct and flow-on economic effects in a small economy



estimation of multipliers for economies requires reliable data (which is often not available below the national level). However it is possible to combine the concepts underlying input-output analysis with indicative data in stakeholder workshops to explore the potential impacts of different development projects or programmes (e.g. the economic impacts of tourist resort development) on small economies. This approach has recently been used as part of a strategic planning and scenario building workshop in Micronesia (see http://www.conservation-strategy.org/en/project/sustainable-economic-development-yap).

3.8 Environmental-economic Accounting

The System of National Accounts (SNA) is a measurement framework that has developed since the 1950s to be the pre-eminent approach to the measurement of economic activity, economic wealth and the general structure of the economy. SNA uses a series of macroeconomic indicators including gross national output, gross national product, income and employment.

Many writers have criticised the design and use of SNA generally for its lack of accounting for stocks of natural assets (natural capital) and change in these stocks (flows) as a consequence of economic activity. SNA has also been criticised for ignoring other forms of capital which constitute a nation's wealth and contribute to the welfare of its citizens, such as human capital and social capital (see section 2.3.1 regarding 'five capitals' and socio-economic resilience).

Over the last few years the UN Statistical Office (United Nations 2012) has been developing the System of Environmental and Economic Accounts (SEEA) Central Framework to overcome limitations in SNA. SEEA has recently become recognised by the UN as an international statistical standard.

SEEA applies the accounting concepts, structures, rules and principles of the SNA to specific environmental assets, to allow for the integration of environmental information (often measured in physical terms) with economic information (often measured in monetary terms) in a single framework. The SEEA describes the interactions between the economy and the environment, and the stocks and changes in stocks of environmental assets in terms of natural inputs, products and residuals.

The SEEA Central Framework provides a means of bringing together, in a single integrated measurement system, information on water, minerals, energy, timber, fish, soil, land and ecosystems, pollution and waste, production, consumption and accumulation. Each of these areas has specific and detailed measurement approaches that are integrated in the SEEA (see Box 1).

Box 1 – Categories of accounts in The System of Environmental and Economic Accounts (SEEA)

The SEEA comprises four categories of accounts.

(a) Flow accounts for pollution, energy and materials provide information in physical terms at the industry level about the use of energy and materials as inputs to production and the generation of pollutants and solid waste. The objective is to see the extent to which the economy is dependent on particular environmental inputs and the sensitivity of the environment to particular economic activities.

(b) Environmental protection and resource management expenditure accounts identify expenditures undertaken by industry, government and households to protect the environment or to manage natural resources. They take those elements of the existing SNA that are relevant to the good management of the environment and show how the environment-related transactions can be made more explicit. In addition, these accounts also measure the use of economic instruments – taxes, subsidies, licence fees and similar tools – to encourage more environmentally friendly behaviour.

(c) Natural resource asset accounts in both monetary and physical terms record stocks of natural resources such as fish, forest, water and minerals, as well as land and ecosystems and changes in these stocks over time.

(d) The final set of accounts within the SEEA describes how the production accounts of the SNA can be adjusted to take into account depletion and degradation of natural capital. When such adjustments are applied to GDP, the result is an environmentally adjusted domestic product – EDP – or what is more commonly referred to as 'green GDP' (See UN, 2012).

Further work is being considered on how to measure other forms of 'capital' in addition to financial, produced, and natural capital such as human capital and social capital (see section 2.3.1. in relation to five capitals and resilience) in national accounts.(United Nations, 2008)

Examples of studies that have used this type of approach

- Pedersen O, De Haan M. (2006). 'The System of Environmental and Economic Accounts–2003 and the Economic Relevance of Physical Flow Accounting'. *Journal Of Industrial Ecology*, 10(1/2), 19-42.
- Smith R. (2007). 'Development of the SEEA 2003 and its implementation'. *Ecological Economics*, 61(4), 592-599.
- Stoneham G., O'Keefe A., Eigenraam M., Bain D. (2012). Creating physical environmental asset accounts from markets for ecosystem conservation. *Ecological Economics*, 82, 114-122.

Relevance of approach for development of an HDN framework

Although SEEA is still being developed, once implemented by governments it should provide a very valuable method of highlighting the value of environmental assets and ecosystem service flows, and the contribution or environmental quality to economic and social development. In future, SEEA may also explicitly consider stocks and flows of social and human capital. However, it is likely to have limited value as basis for an HDN framework due to high data collection requirements, time frame for recording changes in stocks and focus on national level accounting.

4. SUMMARY OF CONCEPTUAL FRAMEWORKS, TOOLS AND METHODOLOGIES

Table 9 below provides a brief summary of the strengths, weaknesses and potential use of the conceptual frameworks, tools and methodologies discussed in previous sections of this report.

Based on the above review and Table 9, it is suggested that promising frameworks which IUCN could build on for the HDN conceptual framework include microeconomics, ecological economics (especially relating to socio-ecological resilience), DPSIR, and institutional analysis. Useful methodologies include cost-benefit analysis and a simplified environmental-economic accounting framework. Further comments on the use of these frameworks and methodologies are given in Section 6, Conclusions and Recommendations.

Table 9: Relevance and uses of frameworks, tools and methodologies

Item	Strengths	Weaknesses	Possible applications to HDN
Frameworks			
Microeconomic approaches	Concern with best use of scarce resources for benefit of society	Limited understanding of social and cultural influences on resource allocation decisions and dynamics of non-monetary economies	Provides coherent, robust basis for explaining resource allocation decisions, and socio-economic factors influencing economic aspects of HDN.
Macroeconomics	Assesses interactions of sectors at whole of economy level	Limited appreciation of value of environmental assets (stocks and flows) and contribution or environmental quality to economic development.	Can be used to examine interactions between households dependent on nature and other parts of the local or national economy. Although providing good insights into such interactions, possibly too limited to provide sufficient basis for a framework by itself
Ecological economics	Specifically includes considerations of equity, social justice, intergenerational equity, sustainable development, ethics	Arguments over scope of factors to include, some schools ideological, others more objective.	Potentially valuable framework which can address issues which are highly relevant to HDN. Concepts potentially could be incorporated in broader dynamic frameworks such as DPSIR
Socio-economic resilience	Useful for assessing factors influencing vulnerability and responsiveness to impacts over time	Limited ability to identify relative importance of different factors influencing adaptation.	Approach can provide some useful insights into community responses to a range of different type of impacts. To have value would need to be incorporated into a broader, more comprehensive conceptual framework addressing other dimensions of human-natural environment relationships.
DPSIR	Very good for explaining strategic influences and responses to impacts.	Conceptual framework, commonly used in SOE reporting, only few known applications to guide users, implied linear relationship of cause and effect	Potentially very useful and flexible framework for showing influence of social, economic, institutional, environmental and technological factors, on a given situation, can integrate ecological, social and economic principles in framework.

Table 9 (cont'd): Relevance and uses of frameworks, tools and methodologies

Tools and Methodologies (contd.)			
Cost-benefit analysis	Consistent, includes direct and indirect impacts relative to base case, useful for assessing distributional impacts on groups and society as a whole including environmental damage costs	Issues with choice of appropriate discount rate, often poorly carried out, difficulties in obtaining data on value of costs/ benefits, often poor understanding of focus on incremental (not total) changes compared to a 'counterfactual'.	Understanding of 'full' social, environmental etc. impacts over time can incorporate qualitative and quantitative assessment of impacts, differential distribution of costs and benefits can be identified.
Cost effectiveness analysis	Simple to understand	Assumes benefits of different options being considered are the same, and given; may act as fait accompli to limit discussion of validity of options per se	May be applicable in limited situations where there is consensus that project should proceed and only question is which way to achieve p[re-determined outcome
BDN	Shows strength of linkages between different variables (nodes)	Complex, mathematical	May be applicable in limited situations to map linkages and influences between different variables of interest
LCA	Shows linkages in production and consumption chain	Limited assumptions about complexities and socio-economic context of resource use	Limited to possible assessments of patterns of resource use to identify scope for improved management practices
MCA	Easy to design. OK for generalised comparisons	Subjective, no theoretical underpinning	May be useful as a simple tool for stakeholder engagement and communication of pros and cons of different options
Input-output analysis	Very good illustrative power of flow on effect (multipliers) and interconnections in an economy	Static, can be complex, but simpler approaches can be used based on indicative data	Simple approach using indicative data can be valuable as a stakeholder engagement/ and communication discussion tool to explore likely impacts on local economics of different development projects or programmes
Environmental accounting and System of Environmental and Economic Accounts (SEEA)	Important in highlighting value of environmental assets (stocks and flows) and contribution or environmental quality to economic development. In future, SEEA may consider stocks and flows of natural, social and human capital)	Still embryonic, large data requirements, only relevant at national scales	Promising approach to better understanding impact of economic activity on natural assets (and other types of capital). Limited value as basis for an HDN framework due to high data collection requirements and time frame for recording changes in asset stocks.

5. A SUGGESTED APPROACH

5.1 Using a DPSIR framework at local and regional scales

The above discussion has considered a range of different (and sometimes related) conceptual frameworks and techniques which have been used to examine socio-economic dimensions of human interaction with, and dependence on, nature.

The majority of the research papers and case studies cited have used microeconomic concepts and related market and non-market valuation techniques to examine human relationships with nature. Rather fewer studies have used other approaches such as examining macroeconomic, or lifecycle, dimensions of HDN. There would be value in a conceptual framework which could be used to assess HDN from different perspectives, and accommodate interactions at different scales from local to international, over different time periods, and in different environments. Such a framework should also be able to incorporate consideration of a range of driving forces and other socio-economic, cultural and institutional influences.

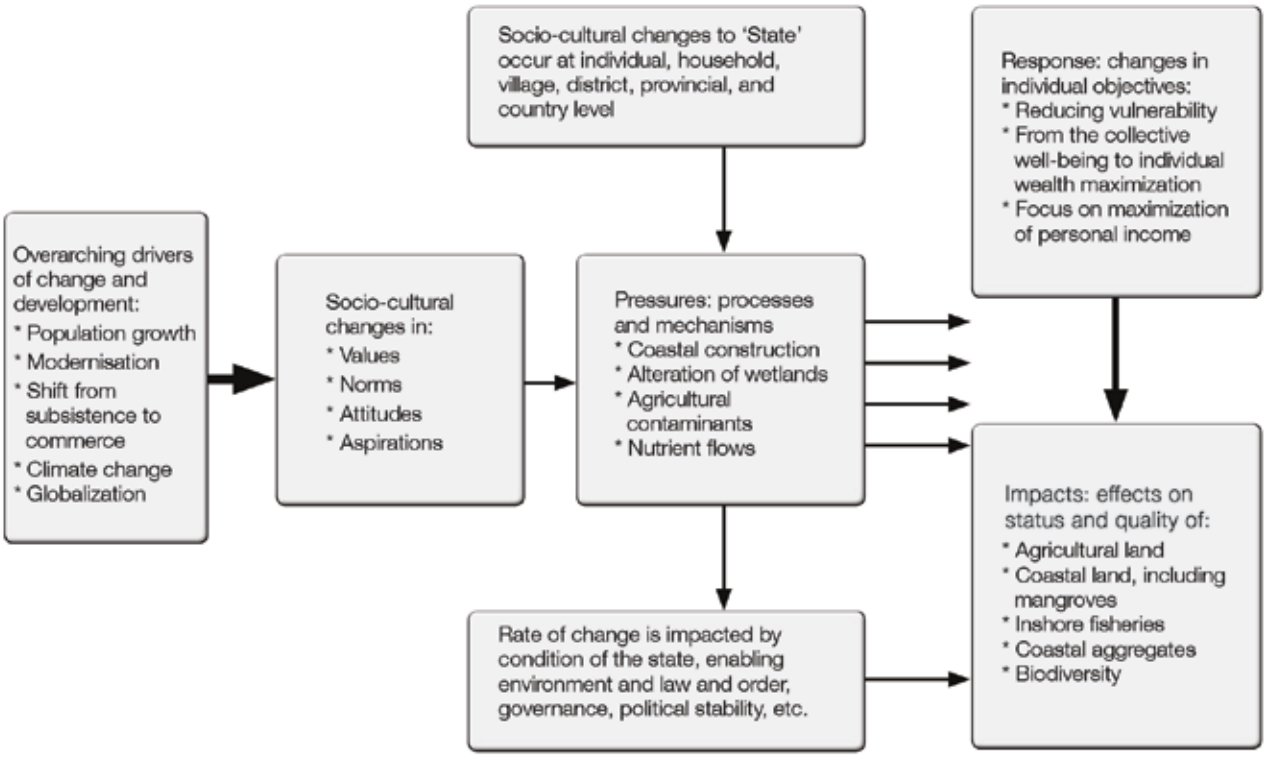
One conceptual framework which may be able to incorporate at least some of these factors is the DPSIR framework discussed in Section 2.4 above. The following section of the report considers how a generalised version of this framework mighty provide the starting point for development of a more comprehensive HDN framework to help meet the objectives of the HDN programme.

5.2 Incorporating economic and social values in an HDN Framework

As described in section 2.4 above, the DPSIR framework can be used to examine the relationship between high level social, technological, environmental, economic and institutional ('political') driving forces, the pressures they impose on communities and economies, and the way such communities and economies respond and adapt to such pressures.

An example of how a DPSIR framework can include macroeconomic-scale issues as well as microeconomic, social, environmental, technological and institutional issues is given in Figure 9, relating to application of this framework to the Pacific context.

Figure 9: A DPSIR framework applied to Pacific issues



Source: Ram–Bidesi et al. (2011)

An example of how the DPSIR framework could be applied in the HDN context is given in Figure 12, and involves the following stages:

Stage 1:

- Envisage HDN in a particular location, community type, ecosystem etc. of interest (i.e. the 'State'). For example, the area of interest may be how HDN relates to a particular ecosystem type such as drylands or wetlands, or to a particular activity (e.g. nomadism) or community group (e.g. aboriginal communities in NSW, see Grey and Altman, 2005).
- Analyse current social, technological, economic, environmental, and political/ institutional factors influencing HDN in that context with regard to use of resources, allocation decisions, and distribution of impacts and socio-economic and environmental etc. outcomes.

Stage 2:

- Identify the socio-economic, cultural, social justice and equity issues relating to this system of HDN, e.g. creation of negative externalities, gender inequalities, loss of tenure rights etc.

Stage 3:

- Identify particular forces, pressures, impacts and responses leading to these social and economic costs/ disadvantages in this system.

Stage 4:

- Identify what can be changed to reduce or remove these negative externalities and improve systematic (including institutional) and structural causes/ influences associated with these disadvantaging factors.

Stage 5:

- Use above information to guide subsequent policy and programme design.

Figure 10 shows this approach in generalised terms.

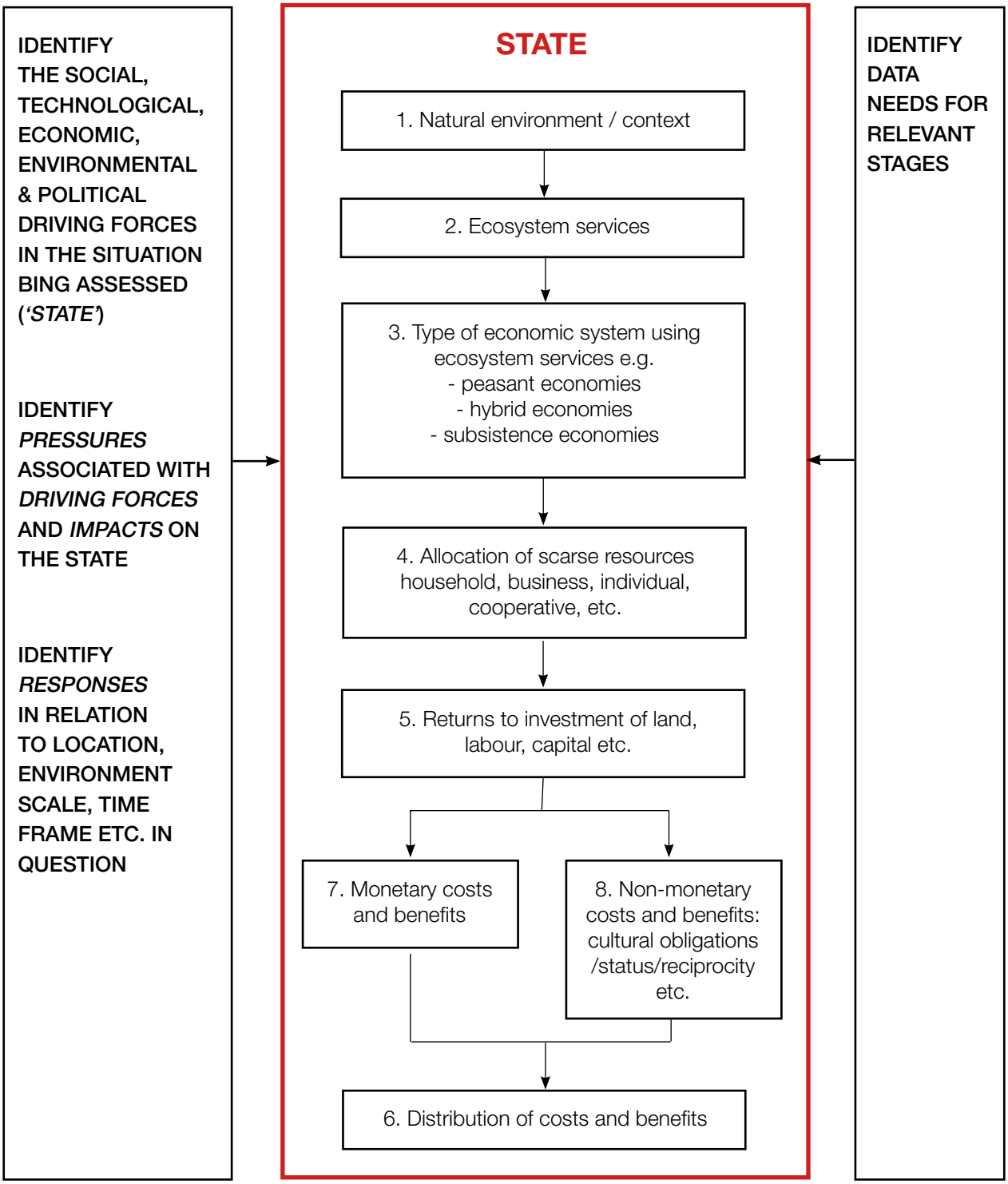
6. CONCLUSIONS AND RECOMMENDATIONS

Some promising conceptual frameworks which IUCN could build on for HDN work include the following: microeconomics, ecological economics, DPSIR, and institutional analysis. Useful methodologies include cost-benefit analysis and a simplified environmental-economic accounting framework.

These frameworks provide guidance on the type of data that would need to be collected to inform analyses carried out under HDN assessments, whether such data was collected through household surveys, interviews, or other primary or secondary processes.

It should be stressed that none of these frameworks provides a single best way that will address all the social, cultural, economic and environmental considerations associated with HDN issues. It is assumed that development of an HDN framework will need to adapt and combine the most salient features of a range of different frameworks and techniques. One particularly fruitful combination could be a combination of DPSIR and institutional analysis. Thus the list above should be seen as starting point for further work.

Figure 10: Possible application of a DPSIR framework to HDN assessments



BIBLIOGRAPHY

References not already cited in the text as examples of studies using particular concepts or techniques.

Altman JC. (2007). 'Alleviating poverty in remote Indigenous Australia: The role of the hybrid economy'. *Topical Issue* No. 10/2007. Centre for Aboriginal Economic Policy Research Australian National University, Canberra. http://www.anu.edu.au/caepr

Argyrous G. (undated). *Cost-benefit analysis and multi-criteria analysis: Competing or complementary approaches?* School of Social Sciences and International Studies, University of New South Wales, Sydney. Accessed 3/7/13 http://www.anzsog.edu.au/userfiles/files/News%20and%20events/CostBenefitMCAAnalysis%20ppt.pdf

Becker J. (2005). 'Measuring Progress Towards Sustainable Development: an Ecological Framework for Selecting Indicators'. *Local Environment*, 10(1), 87–101.

Beaumont N., M. Townsend, Mangi S., & Austen MC.(2006) *Marine Biodiversity: an economic valuation; Building the evidence base for the Marine Bill*. London: Department for Environment, Food and Rural Affairs.

Conner N. (2011). 'Socio-economic Assessment of Pacific Coastal Management'. In Lal P.N., and Holland P. (2011). *Integrating Economics into Resource and Environmental Management: Some Recent Experiences in the Pacific.* Gland, Switzerland: IUCN, and Suva, Fiji: SOPAC.

Emerton L., Seilava R., & Pearith H. (2002). 'Bokor, Kirirom, Kep and Ream National Parks, Cambodia: Case Studies of Economic and Development Linkages'. *Field Study Report, Review of Protected Areas and their Role in the Socio-Economic Development of the Four Countries of the Lower Mekong Region*, International Centre for Environmental Management, Brisbane and IUCN – The World Conservation Union Regional Environmental Economics Programme, Karachi. http://cmsdata.iucn.org/downloads/casestudy03ream.pdf

Emerton L., & Bos E. (2004) *Value. Counting Ecosystems as an Economic Part of Water Infrastructure*. IUCN, Gland, Switzerland and Cambridge: IUCN.

Fisher B., Turner R., Morling P.(2009). 'Defining and classifying ecosystem services for decision making'. *Ecological Economics*, 68(3), 643-653.

Gowdy JM. (2000). 'Terms and Concepts in Ecological Economics'. *Wildlife Society Bulletin*, 28(1), 26-33.

Haines-Young R & Potschin R. (2011). *Common International Classification of Ecosystem Services (CICES)*: 2011 Update. Paper prepared for discussion at the expert meeting on ecosystem accounts organised by the USD, the EEA and the World Bank, London, December 2011. University of Nottingham, UK: Centre for Environmental Management.

Han, S-Y. &; Lee C-K. (2008). Estimating the value of preserving the Manchurian black bear using the contingent valuation method. *Scandinavian Journal of Forest Researc*h, 23(5), 458-465.

Imperial MT. (1999). 'Institutional Analysis and Ecosystem-Based Management: the Institutional Analysis and Development Framework'. *Environmental Management*, 25(4), 449-465.

Johnson D.R. (2000). 'National Parks and Rural development in Alaska', in Machlis G.E. and Field D.R. (eds.) (2000). *National Parks and Rural development- Practice and Policy in the United States*. Washington D.C.: Island Press.

Lal P.N., and Holland P.(2010). *Economics of Resource and Environmental Project Management in the Pacific*. Gland, Switzerland: IUCN, and Suva, Fiji: SOPAC.

Millenium Ecosystem Assessment (2005). *Ecosystems and Human Wellbeing: Synthesis*. Washington D.C.: Island Press.

National Parks & Wildlife Service (2001). *The Contribution of Sturt National Park, Kinchega National Park & Mutawintji National Park to Regional Economic Development*. Hurstville, New South Wales: National Parks and Wildlife Service.

New Zealand Ministry for the Environment (2011). *The Pressure-State-Response framework*. http://www.qualityplanning.org.nz/monitoring/intro-pressure-state-response-framework.php (accessed 23 March 2011).

Nelson R., Brown PR., Darbas T., Kokic P., & Cody K. (2007). *The potential to map the adaptive capacity of Australian land managers for NRM policy using ABS data*. Canberra: Australian Bureau of Agricultural and Resource Economics.

Ostrom E. (2011). 'Background on the Institutional Analysis and Development Framework'. *The Policy Studies Journal,* 39 (1).

Ram-Bidesi V., Lal PN., & Conner N.(2011). *Economics of coastal Zone management in the Pacific*. IUCN, Gland, Switzerland and Suva, Fiji: IUCN.

Robichaud W., Marsh CW., Southammakoth S., & Khounthikoummane S.(2001). *Review of the National Protected Area System of Lao PDR*. Lao-Swedish Forestry Programme, and Division of Forest Resources Conservation (Department of Forestry), Vientienne, Laos: IUCN.

Seidel H., & Lal PN.(2010). *Economic value of the Pacific Ocean to the Pacific Island Countries and Territories*. Gland, Switzerland: IUCN.

United Nations (2008). *Measuring Sustainable Development*. Report of the Joint UNECE/ OECD/ Eurostat Working Group on Statistics for Sustainable Development. New York and Geneva: United Nations.

United Nations (2012). *System of Environmental Economic Accounting 2012— Central Framework*. White cover publication, pre-edited text subject to official editing. New York: United Nations Statistical Division.

APPENDIX 1: ECONOMIC VALUE

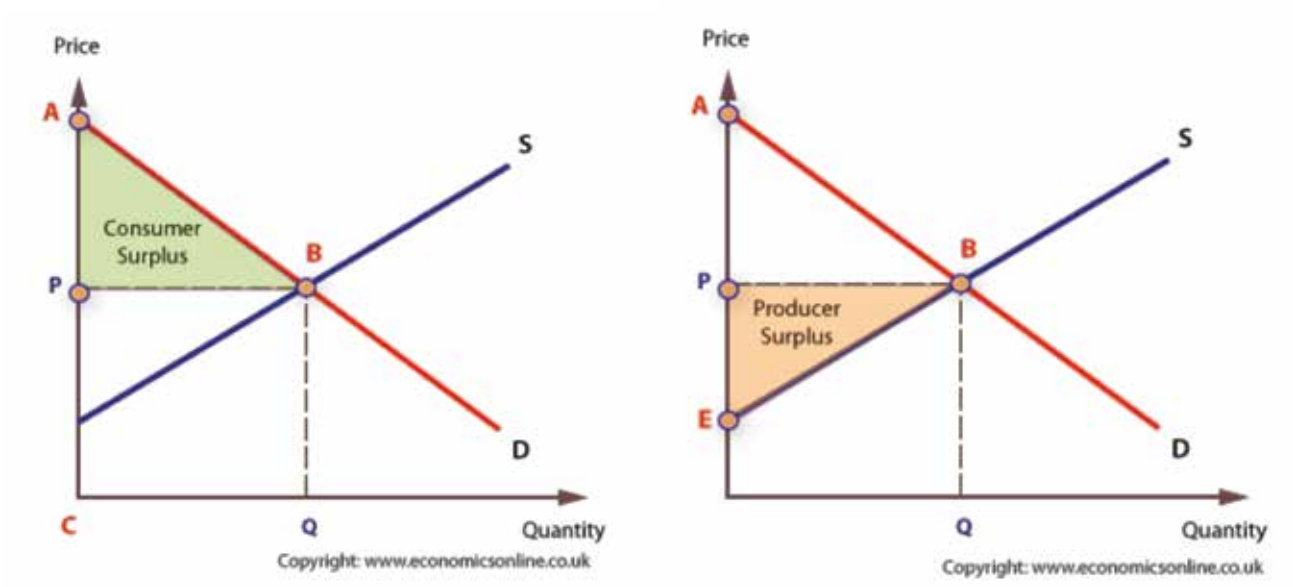
The Market price of a good is not its economic value as:

- goods and services not provided in competitive markets are implicitly assumed to have zero value.
- people may be willing to pay more than the market price for a good.

The amount that people are willing to pay above what they actually pay is the correct measure of the value of a good or service to consumers (i.e. consumer surplus).

The supply curve (S) represents the minimum payment that producers would be willing to receive for goods they provide. If producers receive a higher price than the minimum price they would sell their output for, they receive a benefit from the sale (i.e. producer surplus)

MEASURES OF ECONOMIC VALUE



Consumer Surplus

Producer Surplus

APPENDIX 2: EXAMPLES OF VALUATION TECHNIQUES (SEE TABLE 8)

A2.1 An example using a market valuation approach

Subsistence values in Ream National Park, Cambodia

- Communities living in/around Ream NP depend on natural env. for livelihoods via fishing, firewood, medicinal plants & construction materials.
- In 2002, 500 boats fished in Ream NP employing 30% of local population (~1,597 households).
- Catch inc. shellfish, crustaceans, lobster, squid, fresh/saltwater fish.
- Annual catch of 537.6 tonnes worth $687,291 p.a. at market prices, or $1,375 per boat.

Other products obtained from Ream NP

- Wide range of forest products gathered in Ream NP, worth $190,672 at 2002 market prices.
- Livestock/crop production in NP had gross value of $520,344.
- Subtracting harvesting costs gave net total value of $721,897 p.a.

Stefan Fussan, https://commons.wikimedia.org/wiki/File:Ream_National_Park_45.jpg

Nicholas Conner

	Gross value (US$/year)	Net value (US$/year)	Average value per user household (US$/year)
Firewood	125,133	112,062	25
Construction wood	23,659	23,659	18
Medicinal plants	10,788	10,788	11
Food	17,695	17,695	18
Roofing materials	13,397	13,397	84
Sub-total, forest products	**190,672**	**177,601**	
Crops	316,594	316,594	119
Livestock	227,702	203,750	143
Sub-total, farming	**544,296**	**520,344**	
Total, forest products & farming	**734,968**	**697,945**	

Adapted from Emerton et al. (2002)

A2.2 An example using a contribution to production approach

The value of cloud forests for water supply

Study of hydrological /socio-econ. benefits of cloud forests in Sierra de las Minas Biosphere Reserve (Guatemala).

60 rivers flow from forests, providing water for irrigation, domestic supplies, industry, hydropower.

Study of value of cloud forest water services for irrigated ag. (staples, cash crops, export crops).

https://www.google.com.au/maps/@16.2247681,-89.0621461,7z

1. Study measured horizontal precipitation in cloud forests; and related effects of land use to stream flow.
2. Socio-economic surveys carried out to estimate value of irrigation, and relate extent of irrigation to available stream flow.
3. Value of water for irrigation assessed by comparing productivity of irrigated agriculture with rain-fed farming (carried out where irrigation not possible).
4. Study assumed 20-30% deforestation took place in two river basins, so irrigated land taken out of production as result of reduced stream flow.
5. Cost of this deforestation and reduced stream flow estimated at $15,000 – $52,000 in lost agricultural net profits.

http://www.heifer.org/join-the-conversation/magazine/2015/holiday/house-of-cardamom.html

Source: Emerton, L., Bos, E. (2004)

A2.3 An example using an avoided cost of replacement approach

The value of wild resources for an Aboriginal community

Method

This study estimated the economic value of Aboriginal use of wild resources from Wallis Lake, New South Wales, Australia through collecting data on catch, level of effort, market value, and contribution to household economy and contribution to community economy. The approach taken was to interview community members to identify collectors and collect information on effort, species type, number harvested, distribution of catch etc. and obtain the prices of species involved from price guides and fish markets.

http://greatlakes.org.au

Findings:

- Minimal directs costs of harvesting to collectors except time, but low opportunity cost of time as collectors often unemployed.
- Big range in activity and value, $468–$1299 per person over 14 years p.a.

http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0008/654965/Fishing-Guide-Recreational-Crab-bing-Wallis-Lake.pdf

Source: Grey et al. (2005), (see p.6 above)

A2.4 An example using a contingent valuation approach

Estimating the value of preserving the Manchurian Black Bear in Jirisan National Park, S. Korea, using contingent valuation

http://en.wikipedia.org/wiki/Jirisan_National_Park

http://www.iucn.org/content/mystique-and-legend-park

- South Korean study estimated the value of the endangered Manchurian black bear associated with preservation programmes ('preservation value').
- Study estimated willingness to pay for preservation in a real-world setting (i.e. in national park, not just preservation in general).
- Used field survey in park which was habitat of bears.
- Survey results gave an estimated preservation value of US$4.99 per household for visitors to Jirisan National Park.
- The annual aggregate preservation value was estimated atUS$3.66m when considering total visitor households.
- Showed visitors to Jirisan National Park strongly support preservation programmes for this endangered wildlife species.
- 'Preservation value' might relate to Bequest value, existence value, or even option value.

Source: Han and Lee (2008)

IUCN is a membership Union composed of both government and civil society organisations. It harnesses the experience, resources and reach of its 1,300 Member organisations and the input of some 15,000 experts. IUCN is the global authority on the status of the natural world and the measures needed to safeguard it.

CEESP, the IUCN Commission on Environmental, Economic and Social Policy, is an inter-disciplinary network of professionals whose mission is to act as a source of advice on the environmental, economic, social and cultural factors that affect natural resources and biological diversity and to provide guidance and support towards effective policies and practices in environmental conservation and sustainable development.

The People in Nature (PiN) Knowledge Basket is an initiative established by the IUCN programme of work and whose development is led by a steering group composed of representatives from CEESP, IUCN secretariat and IUCN members. As described in the 2017-2020 CEESP mandate, PiN will promote learning to improve our understanding of how nature contributes to local livelihoods and well-being. It will focus on material use while recognising that use is embedded within worldviews that include deep-seated cultural norms, values, and understandings. It will also consider symbolic interrelationships with nature expressed through cultural narratives, language, and traditions, including diverse understandings of sacred and divine aspects of nature and our relationship with natural resources. This work will contribute to valuing and conserving nature through understanding the value of nature to human societies.