



Survey

An evaluation of monetary and non-monetary techniques for assessing the importance of biodiversity and ecosystem services to people in countries with developing economies

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ABSTRACT

Biodiversity supports a range of ecosystem services that are of fundamental importance to people in poor countries. Economic valuation of biodiversity is important for the development of policies that protect biodiversity and alleviate poverty. This paper provides an evaluation of monetary and non-monetary techniques for assessing the value of biodiversity to people in least developed countries (LDCs). Specifically, research questions include:

- 1) To what extent have monetary and non-monetary techniques been used to assess the value of biodiversity and ecosystem services in LDCs?
- 2) What are the key methodological, practical, epistemological and policy challenges to assessing the value of biodiversity and ecosystem services in LDCs?
- 3) How can valuation methods be improved to allow more accurate valuation in LDCs?

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1. Introduction

Biological diversity underpins ecosystem functioning and the provision of ecosystem services that are essential in supporting human existence, for health, well-being and the provision of livelihoods (Costanza et al., 1997; Daily, 1997; MA, 2005; Sachs et al., 2009; Secretariat of the Convention on Biological Diversity, 2000; TEEB, 2010a). Global biodiversity is increasingly threatened by a range of drivers of change, including population and economic growth, land use change and climate change. As a consequence, biodiversity continues to decline at unprecedented rates (Butchart et al., 2010; MA, 2005; Stern, 2006; TEEB, 2010a; Turner et al., 2009; United Nations, 2007; WWF, 2006). Despite international commitments (through among others the Convention on Biological Diversity), the target agreed by the World's governments in 2002 'to achieve by 2010 a significant reduction of the current rate of biodiversity loss at the global, regional and national level' has not been met (Secretariat of the Convention on Biological Diversity, 2010).

Much of the World's biological resources are located in least developed countries (LDCs) (Fisher and Christopher, 2007) and it is likely that the drivers of change will have a disproportionately higher impact on biodiversity in these countries (Secretariat of the Convention on Biological Diversity, 2010). Furthermore, it is often the people from these poorest nations that have the greatest immediate dependency on biodiversity and ecosystem services to meet their basic needs. Thus, it is likely that the poor will face the impacts of biodiversity loss more rapidly and severely (MA, 2005; Secretariat of the Convention on Biological Diversity, 2010). Developing an understanding of the relationship between biodiversity and the benefits that it provides to the poor is therefore essential to develop policies that both protect biodiversity and sustain the livelihoods of people in LDCs.

An increasingly important aspect of effective conservation and development policies is the valuation of biodiversity and associated ecosystem services (TEEB, 2011b). The Convention on Biological Diversity (CBD) states that '... economic valuation of biodiversity and biological resources is an important tool for well-targeted and calibrated economic incentive measures' and encourages the Parties to 'take into account economic, social, cultural, and ethical valuation in the development of relevant incentive measures' (CBD's Conference of the Parties, Decision IV/10). The CBD's commitment to utilising biodiversity values was further strengthened in 2011 through the Aichi Biodiversity Targets in which it set governments with the goal that 'By 2020, at the latest, biodiversity values have

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been integrated into national and local development and poverty reduction strategies' (CBD Conference of the Parties, Decision X/2). Understanding the true value of biodiversity and ecosystem services and embedding these values in decision-making therefore appears essential for ensuring more equitable and sustainable policies. The recent TEEB initiative provides useful guidance on how the economic value of biodiversity and ecosystem services might best be incorporated into decision making at: the national and international policy level (TEEB, 2011b); the local and regional policy level (TEEB, 2011a); by businesses (TEEB, 2011c); and by citizens (<http://bankofnaturalcapital.com/>).

Over the past few decades, environmental and ecological economists have developed a range of methods capable of measuring the value that people attain from biodiversity and associated ecosystem services (Christie et al., 2006; Eftec, 2006; Nunes and van den Bergh, 2001; TEEB, 2010a). Most of this research, however, has been conducted in the most developed countries (MDCs) (Abaza and Rietbergen-McCracken, 1998; Georgiou et al., 2006; van Beukering et al., 2007), and currently there is only limited data on the value of biodiversity and ecosystem services in LDCs (TEEB, 2010a). A significant cause of this discrepancy is that many LDCs simply cannot afford to invest in research (May, 1998) or lack the technical capacity to undertake such studies, though there are many other challenges to conducting biodiversity valuation in LDCs.

In this paper we argue that research is urgently needed to review, refine and develop new and innovative approaches to valuing biodiversity in LDCs. We address this issue by providing a review and critique of the monetary and non-monetary valuation techniques currently used to value biodiversity in LDCs. Specifically, we ask the following questions:

- 1) To what extent have monetary and non-monetary techniques been used to assess the value of biodiversity and ecosystem services in LDCs?
- 2) What are the key methodological, practical, epistemological and policy challenges to assessing the value of biodiversity and ecosystem services in LDCs?
- 3) How can valuation methods be improved to allow for more effective valuation in LDCs?

In this paper we: (1) provide a brief overview of approaches available to value biodiversity and associated ecosystem services; (2) outline the methodology used to identify and evaluate past research on valuing biodiversity and associated ecosystem services to address the key research questions above; (3) present the results; and (4) highlight key conclusions and recommendations. In addition, we present a case study (in Box 1) of valuing forest ecosystem services in the Solomon Islands to demonstrate how some of our recommendations might be adopted in practice.

2. Valuing Biodiversity's Contribution to Human Welfare and Livelihoods

2.1. Biodiversity, Ecosystem Services and Value

Biodiversity is important for its intrinsic value, but also because it delivers and sustains a wide range of benefits that contribute to people's well-being and livelihoods. Early biodiversity valuation studies tended to focus on the valuation of an individual species or habitats (Nunes and van den Bergh, 2001), while more recent research effort focuses on the more holistic 'ecosystem services' approach to biodiversity valuation (Defra, 2007). The ecosystem service approach recognises the role of biodiversity in underpinning ecosystem functions, which in turn help sustain the delivery of important ecosystem services that people value (Haines-Young and Potschin, 2008; TEEB, 2010a). Although there is debate on the precise definition and classifications of ecosystem services (Boyd and Banzhaf, 2007; Fisher and Turner, 2008; TEEB, 2010a), the most widely used is that from the Millennium Ecosystem Assessment (2005), which classifies ecosystem services into provisioning services (e.g. food, fibre, genetic resource), regulating services (e.g. climate

regulation, water regulation, pollination), cultural services (e.g. aesthetic values, recreation and ecotourism, spiritual and religious values) and supporting services (e.g. nutrient cycling, soil formation) (Table 1).

Both the MA (2005) and TEEB (2010a) distinguish between the economic, social and ecological benefits of biodiversity. However, most research on valuing biodiversity has focused on the economic benefits, where value is generally measured in monetary terms (Farber et al., 2002). This provides a common currency for decision-making, allowing the benefits of maintaining biodiversity to be directly compared with the costs, as well as allowing biodiversity policies to be directly compared with other development goals (Balmford et al., 2002). A useful heuristic device that shows how different components of economic value for biodiversity together provide benefits to people is that of 'Total Economic Value' (TEV). TEV provides an anthropocentric view of the instrumental value of biodiversity and includes both use and non-use values. Use values include *direct use* benefits (such as the consumption of provisioning and cultural services), *indirect use* benefits (through the contribution of biodiversity to the maintenance of regulation services), and *option value* (where people attain satisfaction from possible future use of provisioning, regulating and cultural services) (Table 1). TEV also includes the concept of *non-use* values, which include *altruistic* values (the satisfaction of knowing that other people have access to nature's benefits), *bequest* values (the satisfaction of knowing that future generations will have access) and *existence* values (satisfaction of knowing that a species or ecosystem exists) (Table 1).

Although TEV provides a useful (and much used) framework in which to value the economic benefits from biodiversity, the concept does have its limitations and therefore may not capture all the benefits that biodiversity provides. Alternative value frameworks include social and ecological values (TEEB, 2010a). *Social* benefits include mental well-being, ethical, religious, spiritual and cultural values, which are often prominent in LDCs (UNEP, 1999); Biodiversity may also deliver *ecological* benefits which include the maintenance of many of the essential life support processes (e.g. soil formation, nutrient cycling). Although such services clearly contribute to people's welfare, the complexity and the indirect nature of the benefits often means that they cannot readily be expressed through monetary valuation techniques (Farber et al., 2002), and non-monetary methods may be required to uncover the importance of these benefits.

2.2. Methods to Assess the Value of Biodiversity and Ecosystem Services

A range of techniques have been used to measure the economic, social and ecological benefits derived from biodiversity and associated ecosystem services. These methods can be broadly classified into two paradigms: *biophysical* methods and *preference-based* methods (TEEB, 2010a). In this paper, we focus on the preference-based valuation methods; which we further divide into *monetary* and *non-monetary* approaches. Table 2 provides an overview of these approaches, while Table 3 provides a summary of the extent to which the various techniques can capture different types of value; also see Christie et al. (2008) for a more detailed critique.

Monetary approaches may be used to capture the economic value of some or all of the elements of TEV. For example, stated preference techniques are capable of capturing both use and non-use values (Christie et al., 2006; Nunes and van den Bergh, 2001), while revealed preference techniques are usually restricted to capturing use values only (Navrud and Mungatana, 1994; Shrestha et al., 2002). Market-based and cost-based approaches do not measure people's willingness to pay for an environmental resource, but provide a proxy measure for direct use value. For example, replacement-cost analysis provides an estimate of the cost of replacing an ecosystem service using technology, e.g. the cost of replacing the protection of mangroves with coastal defence works (Gunawardena and Rowan, 2005).

Often monetary valuation of biodiversity can be too challenging (especially when complex ecosystem services are investigated:

Box 1

Valuing ecosystem services in the Solomon Islands: a deliberative and participatory approach.

Introduction

This case study, based on research by [Kenter et al. \(2011\)](#), focuses on a novel deliberative choice experiment that aimed to value ecosystem services in Kahua, a remote and isolated region of the Solomon Islands. Kahua is a region of high species endemism and therefore is globally important for its biodiversity ([Green et al., 2006](#); [Lamoreux et al., 2006](#)). In addition, the indigenous population has a high dependence on local biodiversity and ecosystem services to sustain their largely subsistence existence. This research aimed to assess the value of forest ecosystem services to the local Kahuans. Innovative aspects of this research include the integration of monetary valuation tools and a participatory action research approach, which helped to overcome many of the challenges associated with biodiversity valuation in LDCs ([Table 4](#)).

Study area

Kahuans are directly dependent on local biodiversity and ecosystem services, relying on subsistence agriculture, fishing, hunting, wild food and non-food harvesting ([Bourke et al., 2006](#); [Jansen et al., 2006](#)). However, they face a number of pressures on their resource base, such as those from logging and mining companies, increasing impacts of climate change ([Donner et al., 2005](#); [Ebi et al., 2006](#)), and rapid population growth ([Bourke et al., 2006](#); [Fazey et al., 2011](#)). Many ecosystem services including provision of building materials, water purification and crop disease regulation are declining. The stress that this causes in communities leads people to look for monetary solutions such as cash crops, but this appears to reinforce many of the problems by intensifying pressure on resources. Traditional customs and values and social cohesion have also come under pressure from the drive for monetary wealth ([Fazey et al., 2011](#); [Kenter et al., 2011](#)).

Aims and methods

The study aimed to value ecosystem services in a transitional society where there is a strong emphasis on subsistence economies, using a participatory approach that aimed to promote capacity building and enhance local learning about complex social and ecological issues. The expectation was that the use of a participatory and deliberative methodology would elicit deeper held values and more sophisticated points of view on environmental goods.

As such a group-based choice experiment was developed where choices were made through continuous deliberation by 46 focus groups with 447 participants in total. Environmental attributes used were water quality, *gue* (*Calamus spp.*, a vine used as rope for building traditional dwellings), subsistence and cocoa gardens. Intervention exercises were added to further stimulate discussion and thinking on key issues in relation to ecosystem services. The focus groups were held in the local language and led by Kahuan facilitators who had been extensively trained by external researchers. This resulted in significant learning processes at three levels: focus group participants, local facilitators, and external researchers (c.f. [Fazey et al., 2010](#)).

Results

Results found that that willingness to pay for three ecosystem services amounted to a substantial proportion (circa 30%) of household income and further increased through the deliberative intervention exercises. The group based deliberative approach combined with the participatory interventions also resulted in significant learning for participants. The consequences of learning on perceptions of the environment included development of a more sophisticated view of ecological-cultural linkages, greater recognition of deeper held values, and greater awareness of the consequences of human actions for the environment.

Implications for biodiversity valuation in LDCs

As is outlined in [Table 4](#), the study shows that use of a participatory, deliberative group-based approach can overcome many of the methodological, practical and policy challenges outlined in [Section 5](#) of the main text. Local capacity building and co-management and a participatory approach from start to finish enhance the value of research for participants and improves research quality. High quality discussion, particularly in combination with appropriate interventions that stimulate analysis and linking social-economic, ecological and cultural processes and change, increases the degree to which deeper held values and more sophisticated perspectives are realised. This is particularly important for capturing the value of the more subtle benefits of biodiversity, such as the cultural ecosystem service of identity formation. While this is obviously desirable, a challenging ‘side effect’ of learning can be that certain values become increasingly lexicographic ([Kenter et al., 2011](#)). In the Kahua study, after a number of deliberative interventions, participants realised the importance of biodiversity to such a degree that they expressed a willingness to sacrifice their whole monetary income in order to safeguard resources. In subsistence societies, monetary incomes are low compared to the extremely high economic value of ecosystem services for livelihoods and well-being. This means that, as valuation requires income constraints to be taken into account ([Arrow et al., 1993](#)), stated preference techniques may not always be able to capture true appreciation for ecosystem services. This can be addressed to some degree by a willingness-to-accept approach, use of non-monetary payment vehicles or more marginal trade-offs between services ([Kenter et al., 2011](#)). Still, significant challenges for estimating the true value of key ecosystem services in developing countries remain, and further methodological innovation is required.

Table 1
The links between ecosystem services and components of total economic value.

Category	Description	Use values			Non-use values
		Direct use	Indirect use	Option value	
Provisioning services	Products obtained from ecosystems e.g. food, fuel, materials for building.	✓		✓	
Regulating Services	Benefits obtained from the regulation of ecosystem processes e.g. climate regulation, water purification.		✓	✓	
Cultural Services	Non-material benefits people obtain from ecosystems and landscape through spiritual enrichment, reflection, recreation, and aesthetic experiences. Also includes the value that people place on the existence of plant and animals.	✓		✓	✓
Supporting Services	Those services necessary for the production of all other ecosystem services. They differ from provisioning, regulating, and cultural services in that their impacts on people are often indirect or occur over a very long time, whereas changes in the other categories have relatively direct and short-term impacts on people.	Supporting services are valued through the other categories of ecosystem services			

Source: adapted from MA, 2005.

e.g. Christie and Gibbons (2011)), or not required or deemed inappropriate. In those cases, researchers have utilised non-monetary approaches to elicit people's preferences for biodiversity (Eftec, 2006; Ormsby and Kaplin, 2005). These techniques range from structured survey techniques such as questionnaires (Terer et al., 2004) and interviews (Kaplowitz, 2001) to more participatory approaches such as participatory rural appraisal (PRA) (King and Faasili, 1999) and participatory action research (PAR) (Mendoza and Prabhu, 2005). While these methods do not provide monetary valuations of biodiversity, they can provide useful information on the importance of biodiversity to people in ways that monetary methods cannot. For example, in-depth interviews and focus groups may allow greater in-depth assessments of the motivations underlying people's value for biodiversity (Kaplowitz and Hoehn, 2001).

Of course, many of these non-monetary techniques are also used to support monetary valuation: for instance, stated preference methods use questionnaires and focus groups to help design and administer surveys. Better understanding and more sophisticated application of non-monetary methods can improve the performance of monetary valuation (Kenter et al., 2011). For example, some researchers have incorporated deliberative and participatory approaches into stated preference studies to provide respondents with more time to think about the environmental good before undertaking the valuation exercise and thus address potential issues associated with the complexity and unfamiliarity of biodiversity (Macmillan et al., 2002) or embedding political economy concepts into valuation (Lo and Spash, 2012; Spash, 2007b). Further, many of the participatory methods such as PRA and PAR were developed for use in LDCs, and the knowledge and insights gained from this experience may provide useful insights into improving monetary-based techniques, as well as providing opportunities to embed valuation into local decision making (Fazey et al., 2010; Kenter et al., 2011).

Finally, there is a range of decision support tools available to policy makers that utilise the value evidence elicited using the techniques outlined above. Tools such as cost benefit analysis and cost effectiveness analysis (TEEB, 2011a) draw on monetized costs and benefits, while

approaches such as multi-criteria analysis provide a framework for comparing both monetary and non-monetary value evidence in decision making (Mendoza and Prabhu, 2005).

3. Method of the Review

To address our research objectives, we reviewed existing literature on biodiversity valuation in LDCs. Specifically, systematic searches of two databases¹ were used to identify relevant studies: (i) the Environmental Valuation Research Inventory (EVRI), which is one of the most comprehensive databases of peer reviewed and non-peer reviewed literature on valuation studies (<http://www.evri.ca/>); and (ii) the ISI Web of Knowledge (WoK) (<http://wok.mimas.ac.uk/>), which is one of the world's largest databases of scientific papers.

The approach used in our searches included elements of systematic reviews (Fazey et al., 2004; Pullin and Stewart, 2006). We used the specific search terms 'biodiversity,' 'species,' 'habitats,' 'ecosystems,' along with terms used to identify the various valuation methods under investigation (see second column of Table 2). The location (country) in which the studies were undertaken was identified from information reported in the paper's title and/or abstract. This approach helped to ensure that our search was both comprehensive within the limits of the search terms and repeatable. Further, given that consistent search terms were used across the valuation methods, the searches produced data allowing comparison of the relative extent to which the different methods have been used to value biodiversity in LDCs. In total, 195 monetary valuation studies in LDCs were identified from the EVRI database, while 183 monetary and 101 non-monetary studies were identified from the WoK. Of these, 97 studies were common across the two databases (Table 2). Once identified, the papers were then reviewed to provide evidence to address the three research objectives.

In our review, we focus on the challenges that are specific to valuation in LDCs. Of course, studies administered in LDCs also face many of the methodological and practical challenges faced by researchers in developed countries. For example, stated preference methods have been subject to significant academic scrutiny over the past few decades (Arrow et al., 1993; Bate, 1994; Diamond and Hausman, 1993; Gowdy, 2004; Limburgh et al., 2002; Nunes and van den Bergh, 2001; Sagoff, 1988). It is not the intention of this paper to dwell on these general issues. The reader is instead directed to the Eftec (2006) report which provides a comprehensive overview of these general issues and challenges.

4. To What Extent are Valuation Studies Conducted in LDCs?

This section addresses research question 1. Specifically, we provide an assessment of: (i) where valuation studies have been conducted; (ii) the extent that the different valuation techniques have been used; and (iii) whether the authors of these studies originate from LDCs. Given the different information held in the two databases, both the EVRI and WoK were used to address the first question, while only the WoK was used to assess the other two questions.

4.1. Where have Biodiversity Valuation Studies been Conducted?

The EVRI database identified a total of 1684 English language studies (from both LDCs and MDCs) that valued biodiversity when the search term 'biodiversity' was used. The results show that since 1990s, there has been a rapid increase in the number of valuation studies (Fig. 1). The majority of studies were conducted in MDCs: 88.4% of studies (1489 studies) were from high income or upper middle income countries. Only 11.6% of studies were conducted in LDCs: 5.6% (94) from lower middle income, 6.0% (101) from lower income countries and

¹ Our review includes published literature up until 2008.

Table 2
Monetary and non-monetary techniques available to value biodiversity.

Valuation approach	Examples of methodologies	Description of approach
<i>Monetary techniques</i>		
Market price approaches	Market prices	Market-price approaches utilise prices from actual markets related to the environmental good as a proxy to the value of that good. Examples include: local trading prices (e.g. Le Roux and Nahman, 2005; Turpie et al., 2003); revenues from tourists to areas of high biodiversity; and the value of bio-prospecting contracts (Nijkamp et al., 2006; Nunes and van den Bergh, 2001).
Market cost approaches	Replacement costs approaches Damage cost avoided approaches Production function approaches	Market-cost based approaches utilise the costs from a market good related to the environmental good as a proxy to the value the environmental that good. Examples include the costs of replacing an environmental service (e.g. soil erosion: Moller and Ranke, 2006), or mitigating environmental damage (e.g. storm protection services from Mangroves: Barbier, 2007). The production function approach focuses on the (indirect) input costs of a particular environmental service to the production of a marketed good (e.g. the ecosystem service inputs into crop production: Amaza et al., 2006). Note that the market-cost approaches do not measure the TEV, but rather a proxy to value.
Revealed preference methods	Travel cost method Hedonic pricing method	Revealed preference methods utilise observations from actual markets related to the environmental good to provide a measure of the value of that good. In the travel cost method, data on the costs of travel to a natural resource are used to evaluate the recreational benefits of that resource (Clawson, 1959; Hanley et al., 2002). Hedonic pricing studies reveal the value of the environmental good through observations in a related market: usually house prices (Humavindu and Stage, 2003). Revealed preference methods are usually restricted to measuring use values.
Stated preference methods	Contingent valuation Choice modelling	Stated preference studies estimate economic values by constructing a hypothetical market and asking survey respondents to directly report their willingness to pay (WTP) to obtain a specified good, or willingness to accept (WTA) to give up a good. Contingent valuation studies tend to elicit WTP for a single policy option (Kramer and Mercer, 1997; Turpie, 2003), while choice modelling also allows values of the attributes of the policy to be assessed (Kenter et al., 2011). Stated preference methods can evaluate all components of TEV.
Participatory approaches to valuation	Deliberative valuation	Participatory and deliberative approaches combine stated preference valuation methods with elements of deliberative processes from political science (Spash, 2007b). Typically, the valuation process is administered through small group activities in which participants are provided with time for reflection, information gathering and group deliberation before valuing that good. In its basic format, deliberation is used address issues of low public knowledge of complex environmental goods (Alvarez-Farizo and Hanley, 2006), however, others argue for more fundamental changes to the social process used in valuation (Niemeyer and Spash, 2001; Sagoff, 1998; Spash, 2008).
Value transfer	Value transfer	Value transfer uses economic information captured at one place and time to make inferences about the economic value of environmental goods and services at another place and time (Wilson and Hoehn, 2006). Value estimates may be transferred as monetary values or value functions conditioned on explanatory variables.
<i>Non-monetary techniques</i>		
Consultative methods	Questionnaires In-depth interviews	Consultative methods are structured processes of inquiry into people's perceptions of an environmental issue. Although both methods tend to be administered to individual respondents, questionnaires tend to focus on gathering quantitative data (Struhsaker et al., 2005), while in-depth interviews collect qualitative data (Gareau, 2007). Neither approach directly elicits economic values, but both are used as a basis of monetary valuation methods such as contingent valuation.
Non-monetary deliberative and participatory approaches	Focus groups Citizen juries Health-based approaches Q-methodology Delphi surveys Participatory rural appraisal (PRA) Participatory action research (PAR)	Non-monetary deliberative and participatory approaches utilise group based activities and participatory and deliberative approaches to attain detailed information about people's relationship with the natural environment. PRA and PAR approaches were developed for use in developing countries and aim to promote local knowledge and enable local people to make their own appraisal, analysis and plans (Chambers, 1992; World Bank, 2008). Citizen juries involve a court-like process in which participants review the available evidence before making final judgements on the future of the environmental good (Kenyon et al., 2001). Health-based valuations measure the combined outcomes of health related factors on the quality and length of a human life: examples include QALYs (Doctor et al., 2004) and DALYs (Briggs, 2003).
Methods for reviewing information	Systematic reviews	Systematic reviews are a rigorous way of assessing and reviewing scientific evidence of the likely outcomes of various actions. A key aspect of systematic reviews is that both the protocols before the systematic reviews are conducted and the final reviews are peer-assessed (Fazey et al., 2004; Pullin et al., 2004).

0% (0) from countries with transitional economies (Fig. 1). The results thus clearly highlight a paucity of valuation studies conducted in the poorest countries.

Data from the WoK was also used to identify which countries the studies were conducted in. Of the 284 papers from LDC countries, 33% (93) were conducted in Africa, 32% in Asia (91), 26% (74) in South America and 9% (26) in multiple continents.

4.2. What Techniques have been Used to Evaluate Biodiversity in LDCs?

The WoK database was also used to provide more detailed information about the relative application of monetary and non-monetary techniques. For each of the techniques listed in Table 2, a search was undertaken that included the name of the technique (e.g. 'contingent valuation,' 'questionnaires,' etc.), terms relating to biodiversity ('biodiversity,'

'species,' 'habitats,' or 'ecosystems'). Papers that were not directly relevant to this review were rejected. Of the 284 papers identified (Table 3): 183 were based on monetary techniques and 103 based on non-monetary techniques. The most widely adopted techniques included contingent valuation (73 papers), opportunity costs (56 papers) and questionnaires (48 papers). No papers were found for mediated modelling, citizen juries, Delphi studies or systematic reviews. Overall, a wide range of approaches have been utilised to evaluate the benefits of biodiversity and ecosystem services in LDCs, of which two-thirds have attempted to evaluate the monetary benefits.

4.3. Do Authors Originate from the LDCs?

In the review, it was considered important to make an assessment of whether expertise existed within LDCs to conduct valuation research.

Table 3
Comparative summary of the merits of monetary and non-monetary methods to value biodiversity in LDCs. Ticks indicate whether a method is affected by a particular issues.

	Monetary techniques											Non-monetary techniques											
	Production costs	Opportunity Cost	Damage Cost	Replacement Cost	Travel Cost Method	Hedonic Pricing Method	Contingent Valuation	Choice Experiment	Deliberative Valuation	Mediated Modelling	Benefits Transfer	Questionnaires	In-depth interviews	Focus Groups	Citizens Juries	Health Based	Q-Methodology	Delphi surveys	Systematic reviews	Rapid Rural Appraisal	Participatory Rural Appraisal	Participatory Action Research	
NO. OF PAPERS IDENTIFIED IN OUR SEARCHES																							
EVRI				21	36	12	121	5															
Web of Knowledge	12	56	9	4	7	2	73	17	1	0	2	48	13	11	0	1	2	0	0	5	11	10	
Overlap between EVRI and WoK				4	7	2	69	15															
TYPE OF VALUE																							
Elicits monetary value	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓												
Elicits use value	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓												
Elicits non-use values							✓	✓	✓	✓	✓												
Values are based on TEV					✓	✓	✓	✓	✓	✓	✓												
Values are based on proxy prices / costs	✓	✓	✓	✓																			
Quantitative description of benefits												✓							✓	✓	✓	✓	✓
Qualitative description of benefits												✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Capable of addressing a wide range of biodiversity issues							✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓
Capable of evaluating provisioning services	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓			✓		✓	✓	✓	✓
Capable of evaluating regulating services	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓			✓		✓	✓	✓	✓
Capable of evaluating cultural services					✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓	✓
Can readily be used to value environmental change							✓	✓	✓	✓	✓					✓							
METHODOLOGICAL ISSUES																							
Generally requires literate respondents							✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓
Can be adapted for use with illiterate respondents											✓						✓				✓	✓	
Allows respondents time to consider and reflect on values											✓						✓	✓			✓	✓	
Requires a fully develop market economy	✓	✓	✓	✓		✓	✓	✓															
Values can be aggregated to the affected population	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓							
Specific methodological issues relating to the application of the method in a developing country context					✓		✓	✓	✓	✓	✓					✓	✓						
PRACTICAL ISSUES																							
Requires collection of new data					✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓
Uses existing data	✓	✓	✓	✓		✓					✓								✓				
Data availability may be an issue	✓	✓	✓	✓		✓					✓												
Requires trained enumerators					✓		✓	✓				✓	✓										
Requires highly trained facilitators							✓	✓	✓	✓	✓			✓	✓	✓	✓			✓	✓	✓	✓
Requires advanced research skills	✓				✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓		✓	✓	✓	✓
Requires the use of local language							✓	✓	✓	✓	✓	✓	✓	✓	✓					✓	✓	✓	✓
Relatively quick to implement		✓	✓	✓						✓	✓	✓	✓	✓			✓			✓			
Involves significant time and effort from respondents	✓									✓	✓	✓	✓	✓	✓		✓				✓	✓	✓
Involves an iterative process to data collection										✓	✓						✓	✓				✓	✓
Administered on individuals					✓	✓	✓	✓				✓	✓			✓	✓						
Administered through groups of individuals								✓						✓	✓		✓			✓	✓	✓	✓
Administered on stakeholders									✓						✓			✓					
Potentially affected by local nuances							✓	✓				✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Flexibility of technique to adjust to account for local nuances / issues										✓	✓	✓	✓	✓	✓		✓			✓	✓	✓	
POLICY ISSUES																							
Empowers local communities to engaged in policy									✓												✓	✓	✓
Engages stakeholders										✓											✓	✓	✓
Data can be readily conveyed to policy makers	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓			✓	✓	✓	✓	✓	✓	✓

Table 4

Challenges associated with environmental valuation research in LDCs, and how they were addressed in the Solomon Islands case study (Kenter et al., 2011).

<i>Methodological challenges</i>	
Literacy and language barriers	Focus groups were held in local language and led by local facilitators, who also recorded choice outcomes. These facilitators were in turn interviewed by the primary researcher immediately after focus groups finished, in order to check the validity of choices made and understand choice motivations. Facilitators were extensively trained to understand the hypothetical nature of the choice experiment (CE) scenarios, which allowed them to effectively convey it to participants. To deal with the low degree of literacy, scenarios were represented by stones in an outside rather than school class setting. They were repeatedly explained before each choice. A relatively simple choice task was also used to reduce cognitive complexity: the CE comprised three ecosystem service attributes at two levels of provision and a cost attribute at three levels.
Lack of education and scientific knowledge	Facilitators were trained to understand ecosystem service concepts, and were able to translate this to local concepts. A warm up exercise stimulated participants to consider their intimate relationship with biodiversity and to discuss change in local resources.
Subsistence economy	A monetary cost attribute was used as locals' had some experience with money through school fees and limited contact with markets. At the start of the study it was unknown whether utilitarian assumptions would be valid. However, results showed that participants had no problem with utilitarian considerations. Nonetheless, low incomes were a barrier to full appreciation of environmental goods, which hindered establishing accurate willingness to pay (WTP) values.
Inappropriate best-practice guidelines	The CE was framed in a locally appropriate and convincing way, through extensive preliminary discussion with local village leaders and facilitators. Scenarios were described as development programmes, funded by a community fund. The cost of the scenario was represented as the required contribution for each household. Attributes were partially framed qualitatively, which would reduce the accuracy of marginal WTP, but improve comprehension. The research also adapted a number of PAR principles: local people were considered to be capable of analyzing their own realities and would be empowered to do so; the main purpose of outside researchers was to catalyze, convene, and facilitate the process; and learning of the participants should be experiential rather than determined by transmissive modes of information delivery managed by outsiders
<i>Practical challenges</i>	
Lack of local research capacity	A partnership was formed between external researchers and a local grassroots organisation, and key aspects of research aims and design established collaboratively. Local research-assistants <i>cum</i> facilitators were trained (instead of conventional use of translators) which led to both local capacity building and improved research quality.
Spiritual and cultural values and nuances	Focus groups were led locally, and facilitators were explicitly asked to digress on cultural and spiritual issues in interviews directly following focus groups. An exercise that explicitly stimulated deliberation on cultural considerations and values was included in the research design.
Gaining access to marginal groups	Women, men and to a limited degree, youth had separate focus groups. Facilitators had received particular training in skills aimed at inclusion and limiting influence of 'big men'. Inclusivity and equality were explicit hallmarks of the collaborating local organisation.
<i>Epistemological challenges</i>	
Validity of utilitarian assumptions	The group deliberative process allowed facilitators to record the decision-making considerations and process, allowing assumptions to be tested explicitly.
Social context and values	Group decision-making was chosen over individual choice as it better corresponded with the normal mode of decision-making in Kahua society. Household willingness to pay was deemed more suitable than social (aggregate) willingness to pay, as aggregate amounts may have been too large to be manageable for participants, given their extremely low monetary income.
<i>Policy challenges</i>	
Lack of awareness of or commitment to the importance of biodiversity	Kahua have, until recently, enjoyed 'subsistence affluence', and as such they didn't possess a traditional conservation ethic, though local leaders were aware of resource pressures. The research approach stimulated deliberation on and realisation of the importance of biodiversity through exercises that elicited traditional ecological knowledge, and stimulated connecting social-cultural and ecological issues, leading to considerable learning in terms of awareness of human impact on the environment and its consequences.
Relevance to local policy and implementation	By eliciting participants' own knowledge rather than inferring outside information, participants expressed commitment to resolving issues they had themselves identified through the participatory research. As such the research itself improved support for local development projects focused on biodiversity conservation and low-impact development. After completion of the CEs, preliminary on-site analysis allowed rapid reporting of results. Implications could immediately be discussed in a workshop where avenues for appropriate action could be identified to safeguard ecosystem service values for the future. Through co-management a strong sense of local ownership of the research was fostered and long-term collaboration allows for follow-up research and support.

To address this, data on authorship of the papers was collated from the WoK data to assess whether studies from LDCs were conducted by researchers in those countries. In 32% (92) of the studies the lead author was from a LDC country, while 48% (136) studies had at least one author from a LDC. However, 61% (173) of the studies were led by an author from a developed country and 49% (138) of the studies only had authors from developed countries.² Thus, while there is clearly some expertise and work published by researchers in LDCs, a significant proportion of published papers appear to have been undertaken with little or no input from researchers in those countries.

² It should be noted that our analysis is based on the author's stated address, and does not account for the situation where an author was originally from a LDC, but is currently working in a MDC. Furthermore, our analysis does not account for the situation where local academics / policy makers had been involved in the research, but were not listed as authors on the papers.

5. What Challenges are Associated with Valuing Biodiversity in Developing Countries?

The second objective of this review was to provide an assessment of the methodological, practical, epistemological and policy challenges associated with applying the monetary and non-monetary techniques to value biodiversity in LDCs, and where relevant identify possible solutions to these challenges. We stress here that local circumstances vary greatly between LDCs, and thus not all of the issues raised below will affect all LDCs. Table 3 provides a synopsis of the key issues and challenges identified in this review, and importantly how these challenges affect the alternative valuation methods.

5.1. Methodological Challenges

The majority of methods reviewed here have their roots in MDCs; the exceptions being rapid rural appraisal (RRA), participatory rural

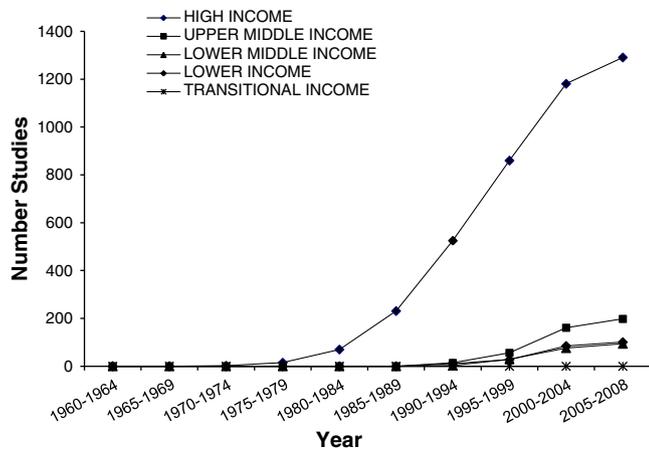


Fig. 1. Cumulative total of biodiversity monetary valuation studies sourced from EVRI for all National Income States from 1960 to 2008.

appraisal (PRA) and participatory action research (PAR) (Chambers, 1992). Application of valuation methodologies in LDCs may thus present particular challenges. Some of these will be general across most methods; while others will be specific to a particular technique or group of techniques, or in a particular local setting. Below we highlight some of the key methodological challenges identified in our review.

5.1.1. Literacy, Language and Articulatory

People in LDCs often have low levels of literacy and in the poorest countries many are illiterate (Whittington, 1998). This creates significant problems for administering both monetary and non-monetary techniques since these methods often rely on respondents being able to read material or complete a questionnaire. Face-to-face methods such as in-person interviews (Bourque and Fielder, 1995) and participatory techniques (Fazey et al., 2010) have often been used to circumvent literacy problems. However, there may still be language issues. For example, in most instances, the study will need to be administered in the local language (Bush et al., 2004). This will require the use and training of local enumerators; which could be an issue in some areas with low levels of education. There may also be issues relating to the capacity of some local languages to express complex issues. For example, Whittington (1992) highlights problems encountered in expressing hypothetical scenarios in contingent valuation studies where the terms 'imagine' or 'suppose' are lost in translation or in some cases the conditional subjunctive is not translatable. Group-based participatory approaches (such as participatory mapping, ranking exercises, transect walks/diagrams, trend diagrams and seasonal calendars) appear to present the best solution to overcoming literacy and language issues (Asia Forest Network, 2002; Jackson and Ingles, 1998; Kenter et al., 2011). Further, participatory approaches tend to better engage respondents and therefore are likely to produce better results (Barton et al., 1997). However, to date, there appears to only have been limited use of participatory approaches in economic valuation studies (Table 3).

5.1.2. Scientific Knowledge and Education

The link between biodiversity, ecosystem services and human welfare is complex (Christie et al., 2006). Scientific understanding of these relationships is likely to be poor in many LDCs (Limburgh et al., 2002). Further, despite a wealth of traditional ecological knowledge, public understanding and knowledge of biodiversity concepts and relationships as they are used in the scientific literature are often low; particularly if there are low levels of literacy (Fazey et al., 2010). It is therefore difficult to employ methods that require respondents to have developed a good understanding of the environmental change (such as stated preference techniques). However, many people in LDCs, particularly in rural

areas, have a highly developed understanding of their local environment attained through activities such as hunting/gathering food or subsistence farming, where individuals need to be aware of and respond to environmental conditions to meet their basic needs. Much of the knowledge that people from LDCs have on the natural environment will be attained through personal experience (experiential knowledge) and will often be implicit or tacit which means it may be difficult to elicit (Fazey et al., 2006). Ways of incorporating this traditional ecological knowledge, which is often embedded in cultural and spiritual values, will therefore be required (Raymond et al., 2010). Further, given that many people in LDCs are unlikely to have previously considered how biodiversity affects their livelihoods, it will be important to provide respondents with 'time to think' about and deliberate these ideas (Whittington et al., 1997).

5.1.3. Subsistence Economies

Many of the poorest LDCs have informal or subsistence economies. Under such circumstances, market prices may be absent or poorly defined, thus making market-price and market-cost based approaches meaningless or distorted (McCauley and Mendes, 2006). Further, if local people are not used to dealing with money on a daily basis, stated preference methods, which ask people to state their maximum willingness to pay, become obsolete. Some researchers have attempted to address this issue by assessing willingness to pay in terms of other measures of wealth, e.g. number of bags of rice (Rowcroft et al., 2004; Shyamsundar and Kramer, 1996). Although this might be valid within a local context, it does not allow values to be readily transferred beyond that economy. Money may also have cultural significance beyond exchange value, such as in money fetishism (Foster, 1998; Snodgrass, 2002), and perceptions of how exchange value is constituted may be different from what is often implicitly assumed by researchers from MDCs (Bloch, 1989; Carsten, 1989; Parry and Bloch, 1989).

5.1.4. Inappropriate Best-practice Guidelines

Most of the methods reviewed in this paper have some sort of guidelines of best practice. However, since most guidelines have been formulated for a developed country context, it is unclear as to whether these guidelines are appropriate in LDCs. To illustrate this issue, consider the case of contingent valuation. The NOAA guidelines for contingent valuation (Arrow et al., 1993) were developed in response to an oil damage assessment in the USA. The NOAA guidelines recommend that the WTP elicitation question should be posed as a dichotomous choice referendum in which payment is made through increased taxation. In some subsistence economies, however, people do not pay taxes, and may not trust the government to deliver policy (McCauley and Mendes, 2006). Further, a bidding game payment vehicle may be more appropriate than a dichotomous choice question in countries where people tend to barter over the price of goods and services (Whittington et al., 1990). If valuation is to be successful in LDCs, then methods will need to be modified to account for local context.

An exception to the above observation is participatory approaches to research (e.g. RRA, PRA and PAR). These approaches were specifically developed to address the challenges of social research in LDCs (Chambers, 1992).

5.2. Practical Challenges

There are a number of practical issues and challenges associated with the administration of valuation studies in LDCs. These challenges include:

Local research capacity: In many LDCs, there is often a lack of local research capacity to undertake valuation research (Whittington, 1998, 2002). There may also be issues with respect to finding local researchers who can both speak the local language and have the capacity to act as enumerators or facilitators (Fazey et al., 2010).

Training of local researchers will therefore be essential for valuation in many LDCs (Kenter et al., 2011).

Spiritual and cultural values and nuances: In many indigenous communities, there may be strong cultural and/or spiritual values of biodiversity, as well as a range of local nuances that need to be adhered to (Whittington, 1998, 2002). It will often be difficult for outside researchers to fully appreciate and account for these in the design of their studies (Bourque and Fielder, 1995). Further, in some instances, the researcher may be completely unaware of such values or nuances; which may undermine the study. The use of trained, local researchers is therefore often essential to ensure that the study is designed to account for these local values / nuances (Raymond et al., 2010).

Gaining access to marginal groups of individuals: In many LDCs, there are significant groups of people who are marginalised from decision making such as women, children, and people in remote villages. Further, individuals in authority (e.g. village chiefs) may assert undue pressure or influence on how people respond to questions. A rigorous sampling frame is required to ensure the inclusion of all relevant individuals. Also, the method used to collect data, e.g. questionnaire, interviews, focus groups etc., needs careful consideration to ensure that it maximises inclusivity and minimises external influences.

Easier administration: Although there are clearly some practical challenges to administering valuation studies in LDCs, Whittington (1998) argues that there are also advantages to LDCs that can facilitate high quality valuation studies: response rates are typically higher than in MDCs; respondents are receptive to listening and considering questions posed; and local research assistants are relatively inexpensive, allowing larger sample sizes.

5.3. Epistemological Challenges

A number of epistemological challenges for valuation in LDCs have also been identified:

Validity of utilitarian assumptions: It is unclear whether the utilitarian assumptions that underlie monetary valuation (Hanemann, 1984) can be upheld in LDCs. Welfare economic theory assumes that individual's seek to maximise their benefit and minimise their cost, and that preferences are stable and transitive (Kahneman, 1986; Urama and Hodge, 2006). Yet in LDCs, many people have low incomes, rely heavily on biodiversity to support subsistence livelihoods and may have limited experience of market mechanisms. This can mean that individuals do not conform to these assumptions of welfare economic theory and that the values expressed in economic markets may not properly reflect the true value of an environmental good or service (Abaza and Rietbergen-McCracken, 1998; Hearne, 1996).

Social context and values: There has also been recent debate relating to the way in which values should be expressed. In neoclassical economics, the focus is upon the expressed preferences of an individual. This generates exchange values, which may subsequently be aggregated and fed into cost-benefit analysis. However, advocates of more politically based approaches to valuation have suggested that people may express their preferences either as individuals, as individuals in a group setting, or as a group (Spash, 2007b). These preferences can be in the shape of individual willingness to pay, or of shared social value, where the latter is an aggregate amount that should be paid by society or collectively (Marglin, 1963; Sagoff, 1998). Shared social values and group preferences may be particularly important with indigenous societies in LDCs, where decisions tend to be made at the clan or extended family level (Kenter et al., 2011).

5.4. Policy Challenges

Valuation is recognised as an important tool to help policy-makers better understand, and therefore account for, all of the ways in which people utilise and value biodiversity. However, there are often obstacles to ensuring that policy-makers in LDCs take full account of the values of biodiversity. These barriers include:

Lack of awareness of, or commitment to, protecting biodiversity: Historically, policy-makers in LDCs were often unaware of the wide range of benefits delivered by biodiversity. However, research programmes such as the recent Millennium Ecosystem Assessment (2005) and TEEB (2010b) have played a valuable role in raising awareness on the links between nature and people (Biggs et al., 2004). Further, Kenter et al. (2011) demonstrate that in some of the poorest and remote regions of the world, indigenous people do possess the capacity to identify the importance of biodiversity resources for livelihoods. There is, however, still some naivety and scepticism relating to the use of valuation methods in LDCs; which appears to stem from the lack of local expertise and experience of these methods in both the research and policy-making communities. A confounding issue is that, in many LDCs, there may be more pressing political issues to deal with: such as war, famine, etc. The consequence of this is that biodiversity protection is often low on the political agenda.

Relevance to local policy and implementation: Evidence from our review indicates that half of the valuation research undertaken in LDCs appeared not involve local researchers or policy-makers. Such research is often purely extractive; the findings may be published in international journals, but the research may have little or no influence on local policy decisions (Barton et al., 1997), and therefore may not benefit local people. Also, local people are unlikely to show any commitment to research outcomes if they have not been involved in the research process (Chambers, 1997; Reed, 2008).

6. Can Valuation Methods be Improved to Allow More Accurate Valuations in LDCs?

In this section, we address research question 3 and propose possible solutions to address the challenges outlined above. It should be stressed that not all proposed solutions will be applicable across all LDCs, and also that some solutions may also be relevant to MDCs. Further, it is important to highlight that standard valuation approaches can also work well in many LDCs, and therefore we do not advocate dismissing standard valuation approaches outright, but rather the researcher should consider what challenges might affect valuation in their specific local context and then adopt the relevant solutions outlined below.

6.1. Use Local Researchers/enumerators

Almost half of the biodiversity valuation research identified in this review failed to involve local researchers or policy makers. Whittington (1998) argues that the failure to utilise local expertise is a significant concern for research in LDCs as it increases the risk that the research will miss important local cultural and spiritual values, which in turn may compromise the validity of the research findings. The use of local enumerators is also important to account for local languages. However, it is recognised that there is often limited or no local research capacity, and therefore extensive training of local enumerators may be essential (Alberini and Cooper, 2000; Kenter et al., 2011). Further, experience has demonstrated that it will also be important to monitor and validate data collected by local enumerators (McCauley and Mendes, 2006). Finally, by embedding local people into the research programme, it is

more likely that the research outcomes will be incorporated into local policy, which in turn will help to alleviate poverty and increase the welfare of the poor.

7. Incorporate Qualitative, Participatory and Deliberative Methods into Valuation

Many of the monetary valuation approaches utilise questionnaires and surveys to collect information on people's values. The review of non-monetary techniques, however, questioned the appropriateness of these approaches in some LDCs: low levels of literacy mean that people may not be able to read questionnaires; language barriers may mean that it is difficult to articulate complex concepts; restricted time during interviews may limit people's ability to develop and express value preferences (Urama and Hodge, 2006; Whittington, 1998).

Qualitative approaches (such as in-depth interviews and focus groups) provide opportunities for the researcher to probe more deeply into people's preferences than could be achieved using either quantitative or economic techniques (Baird and Flaherty, 2005). Such detailed insights may be extremely useful for uncovering local cultural and spiritual values that might not be directly transparent to external researchers. Further, the insights gained from qualitative research can provide important supplementary information that might be useful to help understand the considerations underlying people's economic values.

Participatory and deliberative approaches offer an alternative approach to the design and administration of valuation studies. Given that participatory approaches such as RRA, PRA and PAR were developed to meet the needs of social science research in LDCs (Chambers, 1992), such approaches can help to ensure that valuation is applied through traditional, cultural or thinking practices, which will help to avoid the problem of imposing a western way of conceptualising environmental goods and services (Asia Forest Network, 2002; Jackson and Ingles, 1998). Participatory and deliberative approaches also provide respondents with 'time to think' about and reflect on their preferences, which has been demonstrated to improve the accuracy of valuation surveys (Kenter et al., 2011; Whittington et al., 1992, 1997). Such approaches may also help to: promote dialogue and deliberation with local people and decision-makers thus fostering ownership and responsibility of problems; promote learning and awareness; and build local capacity to analyse problems and make more effective collective decisions (Chambers, 1997; Reed, 2008; Wadsworth, 1998). The incorporation of participatory and deliberative approaches into the valuation process would suggest that valuation draws on the practices of anthropologists, ethnographers and other qualitative researchers, though this brings additional challenges in bridging the epistemologically different disciplines.

Current efforts to incorporate participatory and deliberative approaches into valuation appear to fall into two schools. First, studies such as Christie et al. (2006) and MacMillan et al. (2002) have incorporated participatory and deliberative approaches into valuation to address concerns that respondents of a typical 20–30 min valuation survey do not possess the time or cognitive capacity to assimilate and process enough information to make meaningful valuations of complex environmental goods. These studies have therefore utilised 1–2 h focus-group workshops in which respondents are presented with more information on the environmental good and provided with opportunities to discuss and reflect on their preferences, thus easing the cognitive burden and improving preference expression. The second school of thought argues that there are more fundamental epistemological issues with valuation, including the fact that valuation tends not to account for non-economical considerations, social or plural values, and rights and procedural fairness (O'Neill, 2007; Sagoff, 1998; Spash et al., 2009). These researchers advocate a type of deliberative monetary valuation (DMV) that incorporates deliberative democracy into valuation (Dryzek, 2000; Spash, 2008). We argue that both approaches have the potential to significantly improve

the way in which the preferences of people from LDCs (and also MDCs) are revealed.

To illustrate how some of the above recommendations might be incorporated into valuation in LDCs, we present the case study of valuing biodiversity in the Solomon Islands (Box 1) as an exemplar of how the use of participatory, deliberative and action research methods can aid the design and administration of valuation, as well as promoting the adoption of research output by local decision-makers.

8. Conclusions

This paper aims to provide a review of studies that value biodiversity and ecosystem services within countries with developing economies. Although our review is comprehensive within the limits of our systematic searches, we wish to highlight some of its limitations, including lack of detailed consideration of the grey literature, limited use of search terms, and that only studies presented through the English language were considered. Nonetheless, we believe that the review does deliver a comprehensive critique of the current state of affairs in biodiversity valuation in LDCs.

The review clearly demonstrates there has been a dramatic increase in the number of biodiversity valuation studies undertaken in recent years; however, most of these studies were conducted in countries with developed economies. Of those studies conducted in LDCs, many appear not to involve local expertise (which presumably was either unavailable or not being used). The consequence of this is that such research is likely to be extractive, may miss local nuances/issues, and is likely to not have a link to local policy-making. To produce results that are meaningful to policy-making, we argue that research needs to include both local researchers and policy-makers. To achieve this, local capacity building in many LDCs will be essential.

There is evidence that standard approaches to valuation may not always be appropriate for application in LDCs. We argue that the incorporation of participatory, deliberative and action research methods into valuation can help improve the robustness of value revelation. Such approaches tend to increase motivation, engagement, ownership and responsibility of the research process and can assist in managing power relationships within communities that could affect the results obtained (Reed, 2008). However, there is considerable misunderstanding of what real participatory research actually entails (Parfitt, 2004). It is not a consultative exercise where research is extracted by external investigators and then analysed elsewhere. Instead, effective participatory research is a process that is embedded within communities and decision-making processes in ways that promote sharing of information and learning (Fazey et al., 2010). By focusing on participation as an end in itself rather than seeing it as a means to which values can be elicited, much greater consideration is given to the cultural aspects that influence the ability of those most marginalized to speak out (Chambers, 1997; Parfitt, 2004). Similarly, there is debate about how deliberation should be included in valuation research (Spash, 2007a). Overall, while there are significant challenges and pitfalls to incorporating participation, deliberation and social learning into valuation (Kapoor, 2001), there is evidence that utilising these methods in valuation research leads not only to better uptake of the results, but can also be more cost effective (Danielsen et al., 2007).

To move towards research that more effectively integrates participatory and deliberative approaches into economic valuation, a perceptual shift in the way economic researchers and the relevant funding agencies view valuation research will be required in countries with developing economies. Projects will need to recognize the challenges of working effectively with local communities, the need to build capacity of local researchers with existing local and traditional knowledge to execute research, and the timeframes required to conduct the work effectively. From a policy perspective, much greater emphasis should be placed on research that actively contributes to capacity building through requiring

more rigorous ways of involving communities in the research, rather than simply using traditional dissemination methods.

Finally, there is currently a political will to extend the evidence base on the economic value of biodiversity and ecosystem services in LDCs: for example, measures within the Convention on Biological Diversity's Aichi targets; the formation of the Intergovernmental Platform for Biodiversity and Ecosystem Services (IPBES); and the UN's recent announcement to extend the 2010 Year of Biodiversity to the 2011–2020 Decade on Biodiversity. These policy initiatives advocate that valuation is fundamental to help protect the world's biological resources, which in turn will help to alleviate poverty and improve the welfare of the poor. If these initiatives are to be successful, both the academic and policy-making communities will need to gather more robust evidence on the value of biodiversity and ecosystem services. This, arguably, will require the development of new and innovative approaches to valuation in LDCs. Also, it will require new approaches to the way that the results of these studies are communicated to local communities and policy makers in LDCs.

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