An Innovative Framework for Evaluating and Managing Ecosystem Services for Sustainable Development in Developing Countries

Animashaun, J.O.; Ajibade, T.B.; and Oloyede, W.O.

Abstract

Ecosystem services are the beneficial outcomes to the society arising from the functioning of the components of the ecosystem. Ecosystem management aims to safeguard the conservation of these components; ensuring that they meet the immediate and long-term socio-economic needs of current and future generation as emboldened in article 15 of the Sustainable Development Goals (SDG). Because of its expediency, the Cost-Benefit Analysis (CBA) framework is often invoked for evaluating and deciding on the efficient and sustainable use of the ecosystem services. However, using the CBA framework for evaluation in the context of resource-poor in many developing countries overlooks some key considerations which may bias policy recommendation. For instance, the monetization of nonmarket functions of ecosystem services, the failure to adequately acknowledge the multiple and perspectival dimensions of human well-being, and the multiple, temporal and supportive uses of natural resources for livelihood functions are some quick examples of criticisms faulting the use of CBA. Non-incorporation of these salient considerations can quickly sort out into several vexing conundrums that draw back from achieving SDG 15 particularly, in many developing countries where many individuals' livelihood is inextricably tied to ecosystem services. In this paper, we elaborate on these issues and suggest the need for more innovative techniques to be incorporated into the CBA framework. Particularly, we recommend a framework for ecosystem management based on valuation that is structured on a pluralistic, multi-discipline, and participatory framework that uses a non-monetary valuation language that has more meaningful and immediate meaning on loss of livelihoods.

Keywords: Biodiversity protection, Cost-benefit analysis, Ecosystem services, Environmental policy evaluation, Innovation techniques

Introduction

Ecosystem services are the beneficial outcomes to the society arising from well-functioning components of the ecosystem and they are used as a heuristic analytical tool to make explicit links between ecosystem conservation and human well-being (Brown et al. 1996, Norgaard 2010). Essentially, the ecosystem involves the networks of interactions among and between organisms and their environment, and the services they generate which could be tangible or intangible (Brown et al. 2007).

Ecosystem management aims to conserve ecosystem components that are less resilient to shocks, while also sustaining their long-term benefits for meeting the socio-economic needs of current and future generation as enshrined in article 15 of the Sustainable Development Goals (SDG) project (*Szaro et al. 1998*). Several studies have established that ecosystem services are key to human well-being and sustainable development with the interactions among these ecosytem services, human well-being, and sustainable development being central to sustainability science (Hu *et al*, 2022; Fu, 2020; Wood *et al.*, 2018; Geijzendorffer *et al.*, 2017; Costanza *et al.*, 2016). According to Hu *et al.* (2022), since 17 sustainable development goals (SDGs) and 169 targets incorporating economic, social, and environmental dimensions of sustainability were proposed by the United Nations in 2015, most countries have made considerable progress towards achieving those SDGs, especially in terms of the elements of socioeconomic development (Sachs et al., 2021). However, much progress made in socioeconomic development was based on the unsustainable exploitation of nature (Hu *et al.* 2022).

Because resources to manage the ecosystem are scarce and given the competing uses over a range of alternatives, debates over ecosystem management involve innovative techniques that prioritise the short and long-term benefits and costs of ecosystem services. Usually, this involves decision makers making trade-offs in resource allocation and the management of the ecosystem. According to Croci *et al* (2021), each ecosystem service offers various benefits, so it is essential to know the expected benefits, in order to select and adopt the appropriate valuation methodology that can capture and complement the ecosystem service values.

One way of prioritisation is by evaluating the benefits and costs associated with depletion or loss of ecosystem services to the society, and this could be done by comparing the private costs and benefits in monetary values associated with such services and the alternative uses. However, ecosystem services are public goods, implying that they generate significant externalities; therefore, the markets prices generated from such transactions would be inefficient at estimating the true welfare cost of their loss to the society. Having a fair value of the ecosystem services is useful for justifying a set of management options that protect or restore ecosystems. Subsequently, policymakers resolve the market failure by applying the Cost-benefit Analysis (CBA) for evaluating the social benefits and costs from ecosystem services.

Application of the CBA in this regard implies the enumeration and evaluation of all relevant monetary values of costs and benefits (social and private) of ecosystem services and practically accessing the potential welfare loss associated with their loss. With this approach, it is possible to aggregate the monetary values, apply a discounting technique to evaluate future benefits and costs, and estimate the total net benefit in terms of Net Present Value (NPV). Nevertheless, the use of the CBA as an informational input in the allocation of resources and informing policy recommendation on the utilisation and conservation of ecosystem services is far from perfect.

The monetization of nonmarket functions of ecosystem services, and the preference elicitation techniques employed in CBA has been the subject of serious criticisms in the literature, tending towards underscoring its insufficiency and inadequacy at appraising ecosystem services. Specifically, these criticisms become more apparent in resource-poor countries, and we can easily think of three reasons why having a proper evaluation of the ecosystem in these regions is critical for realising goal 15 of the SDG.

First, because most of the world's natural resources are concentrated in developing countries, the pressure on developing economies is high to take on greater responsibility for their management to ensure sustainable development (Euston 2012). Second, the high reliance on the natural resource as the main source of food and labour employment in many developing countries may render the traditional use of the CBA in the evaluation of ecosystem services unsuitable for sustainable development. For instance, while a high concentration of labour is often observed in the agricultural sector, the wage usually paid for this labour is not commensurate to the benefits derived.

Specifically, in developing regions, majority of family and household labour employed for agricultural activities workers of these regions do not enter into formal wage employment. This unpaid family labour usage in agriculture, and especially subsistence farming, are usually significant and are not usually accounted for as part of the cost of production activities (Euston 2012). This therefore suggest that we are prone to understating a proper accounting of the relevant costs and benefits. Third, and more importantly, the individual and/or group judgment on the values of ecosystem conservation in resource-poor countries are likely perspectival; inspired by the historical, social, cultural and economic needs, which are likely to bias cost and benefits assessment.

Therefore, in this paper, we investigated the use of CBA as used in the context of developed countries. We highlight the salient features of the CBA that make it an attractive choice for the analysis of ecosystem services and we point out its main criticisms. We constructed an innovative framework for ecosystem evaluation that can be a practicable input in the debate surrounding ecosystem management. Our framework considers the complexities among the underlying causes of biodiversity loss in resource-poor countries.

Costs-Benefit Analysis (CBA) as a Tool for Ecosystem Services Valuation

Rapid urbanization and expansion of human habitation have led to the encroachment on the ecosystems and imposed considerable demands on the services they provide. Because these demands cannot always be fulfilled given the limited ecosystem services, trade-offs are usually made by policymakers to identify the ecosystem services with the highest opportunity cost. Without any doubt, making such choices can be a complex and daunting task (Wenger and Pascual 2011), and cost-benefit analysis is often considered an effective tool to guide this choice (Hanley 2001). For instance, the decision maker is often faced with the choice of allowing the rainforest to be cleared to allow for plantation agriculture that provides food for the population or to allow for road and housing construction or is left intact to protect and support the extensive flora and fauna biodiversity.

In another instance, the decision might be entirely in the hands of the immediate community that have relied on the ecosystem services over the years for livelihood support. Should a poor and hungry farmer hunt down endangered animals or rare species to fulfil his/her immediate needs of food security? To answer these questions, one can easily think of estimating the market value of worth of the biodiversity and the alternative use in terms of the value of food or the additional income that comes with the expansion urban expansion. However, because ecosystem services are public goods and they generate significant positive externalities, relying on only the market price would not yield a socially efficient outcome.

To address this, policymakers rely on the CBA framework as a tool for ecosystem valuation. The CBA has been widely justified due to some appealing features that make it suitable for overcoming the market failure that characterised traditional market valuation. As shown in Wegner and Pascual (2011), the main appealing features of the CBA in ecosystem services evaluation border on: first, expediency, which is about its ability to deal with the large and ubiquitous nature of human needs and by expressing ecosystem services in economic terms to guaranteed a better understanding public decisions (Turner et al. 2003). Second, is it democratic appeal, by treating all individual preferences as equal, and upholding the one person one vote one preference dictum, it has the appeal of democratic approach to decision-making which generates a preference measure that is representative.

Third, CBA is value-neutral. While ecosystem functions are value-neutral, their services, however, have value to society. Value-neutrality implies the independence of individual choice and preference from a value system. Finally, CBA ensures the inescapability of trade-offs. Because individuals would have to make a choice given a set of alternatives, then it is assumed that the one that has the highest utility maximising potentials would be chosen and hence, useful in determining the opportunity cost. With this trade-off, it is possible to evaluate the benefits in terms of the utility of the ecosystem service relative to the opportunity foregone.

Nonetheless, several studies have critically examined these features and demonstrate why they are not only violated but also, are premised on weak assumptions. Nyborg (2014) makes a critical attack on the notion that CBA is representative. A fundamental requirement of any democratic decision-making, it argues, is to demonstrate that every individual has an equal opportunity to discover and express reasons for her views (Dahl, 2006). It argues that the welfare measures used in CBA are based on indicators that are highly subjective and prone to value judgements. In essence, the CBA falls short of achieving the democratic principles of liberty in the sense of limiting the views to an expressed value judgment. Moreover, the CBA does not recognise the ephemeral nature of power and the intrigues that often characterise democratic decision-making processes. Given these shortcomings, Nyborg (2014) argues that using CBA for ecosystem valuation could fail and suggest that the need for a universal language that is more understandable in a democratic setting. It argues for using cost– impacts analysis that is calculated like in standard CBA, but with no requirement of monetary valuations.

In another study, Wegner and Pascual (2011) argue that the normative premise that underlies cost-benefit analysis is unpractical and fall short of covering the multiple, complex and pluralistic dimensions of human well-being and the non-linearity of changes in the ecosystems. It argues that because of information asymmetry in terms of individuals' perception of ecosystem benefits, the value ascribed to environmental goods are usually interdependent on other people's choices. Also, the contexts in which people process information are intrinsically different and are institution and context-specific. Aggregating all values on a single scale of the measure could yield biased estimates as a willingness to pay may not constitute a universal indicator of the value that people hold towards ecosystem services.

The obvious consequence of this is that CBA may offer an unreliable guide for the independent decision-making process. Also, valuing ecosystem services through prices is not democratic for the obvious reason that the distribution of wealth in a society is not democratic (Spash, 2008, Sen 2000). Also, the margin of error in CBA could be increased if it does not recognise the complex and geographically and temporally extensive scale of ecosystem services. Wegner and Pascual (2011) therefore suggest for replacing the CBA in ecosystem services for policy evaluation with a more pluralist framework that comprises a heterogeneous set of value-articulating tools that are context specific (Wegner and Pascual 2011).

Nyborg (2000), in another study, clarifies the dual roles and responsibilities of the individual valuing the perceived usefulness of environmental good and show how this duality could bias individual's valuation of the ecosystem benefits. First, each is driven partly by her interests and also by the collective interest of the society. Pointing out this distinction is necessary because consumers could be driven more by altruism, ego and/or moral commitment than by perceived usefulness of the environmental good when reporting preference. Because of these dual roles, there might be multiple preference orderings in the context of environmental valuation. It conceptualises this assumption by categorising consumers and citizens, as *Homo Economicus* or *Homo Politicus*, using well-known concepts from neoclassical welfare economics.

The research of Atkinson et al. (2012) shows that the use of CBA raises a difficult fundamental challenge that more importantly stresses the need for interdisciplinary collaboration and exchange of thoughts from other branches of sciences and economics. It argues that thinking of ecosystems in terms of assets could correct some of the crucial issues arguably neglected in most of the valuation literature, particularly, the way future services are valued when an ecosystem asset undergoes some change.

Another issue raised by Euston (2012) is the marked differences in the labour markets between developing and developed economies that could significantly influence the results of cost-benefit analysis. Because of the poorly developed service and manufacturing sectors, agriculture and the natural resource sector constitute the major employer of labour in many developing countries. In Nigeria, for instance, agriculture employs a significant fraction of the labour force. However, because of the high unemployment rate, the labour supplied by this labour force does not reflect the real transaction cost using conventional cost-benefit analysis which uses the cost of labour using the wage rate. In Table 1, we summarise the contrasts between the classical assumptions of CBA and how these are negated by the practical realities based on human behaviour and properties of the ecosystems.

Table 1: Classical assumptions in CBA versus the practical realities of human behaviour and ecological properties

The underlying assumptions of the theoretical framework in CBA	**Practical Realities**
Well-being is unidimensional; it consists essentially of utility maximation	Well-being could be pluridimensional. It involves the fulfilment of plural capabilities (including psychological, social and cultural)
Value is utilitarian - Total Economic Value (TEV)	Value could be intrinsic; nature could be invaluable
All values/preferences exist ex-ante and can be elicited by individuals in isolation (methodological individualism)	Some values/preferences need to be socially constructed through collective communication
The linearity of change in ecosystem values (Marginal and relative value)	Ecological non-linearity, complexity and resilience
Prices and values are neutral measures of values/preferences	Prices are influenced by the distribution of wealth, status seeking and could be motivated by religious or deontological views
Values/preferences are exogenous, consistent and stable	Values/preferences can be endogenous, could be immeasurable with money and could be dynamic
All values/preferences can be measured on a Cardinal scale and compared across individuals	The values/preferences of heterogeneous groups of people cannot be measured on a Cardinal scale and compared across individuals

Source: Adapted from Wegner and Pascual (2011)

An Innovative Framework for Sustainable Ecosystem Management in Developing Countries

By way of introduction, the submission of Budden and Murray (2018) on innovation is worthy of mention in the context of our approach in this paper in that it highlighted that innovation takes place in complex ‘systems’ which means there are no singular ‘magic bullet’ policy solution but rather a collection of policy interventions. Given the practical realities of the psychological, hermeneutic and interpersonal understanding of human behaviour, the non-linearity of ecological change and pluralistic uses of ecosystem services, the normative foundation of the CBA may be inadequate in appraising the full benefits and costs of ecosystem services. A crucial aspect of attaining the Sustainable Development Goals 15 is biodiversity conservation, that is, for the ecosystem services to meet up to current benefits without compromising future generations’ livelihood. However, the projected population growth and the respective growing pressures on ecosystems services stemming from current limitations in the framework used in the assessment of important components of the ecosystem services might compromise this objective. Quantitative estimates show infeasibility of zero net deforestation and biodiversity targets unless of course, we devise new means of evaluation, management and prioritisation of benefits and understanding of cost associated with biodiversity loss. Indeed as shown in Figure 1, evidence of loss of forest area cover is very high in many developing countries signaling that significant effort is required to stem the rate of deforestation in these regions (FAO 2015).

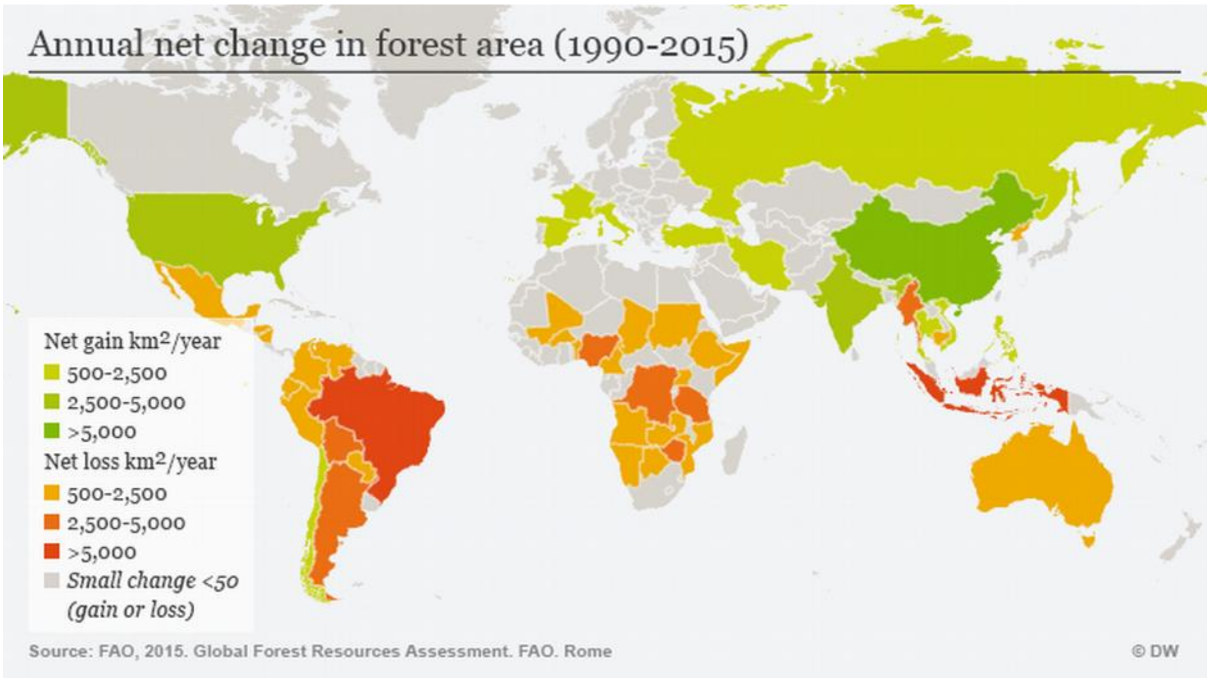

Figure 1: Annual net change in forest area 1990-2015 (Source: FAO 2015)

In addition, the map on global biodiversity hotspots and development levels as measured by the Human Development Index (UNDP) show that some of the world's least developed countries are also located in hotspot areas of high importance for biodiversity (Figure 2) (Slingenberg et al. 2009). In countries with low HDI, human encroachment into high-value biodiversity areas is more likely because of the greater dependence on ecosystem services as a source of livelihood. This suggests the rationale for greater effort for making conservation effort, ecosystem management and strategies for maintaining biodiversity a top priority in the world's poorest countries.

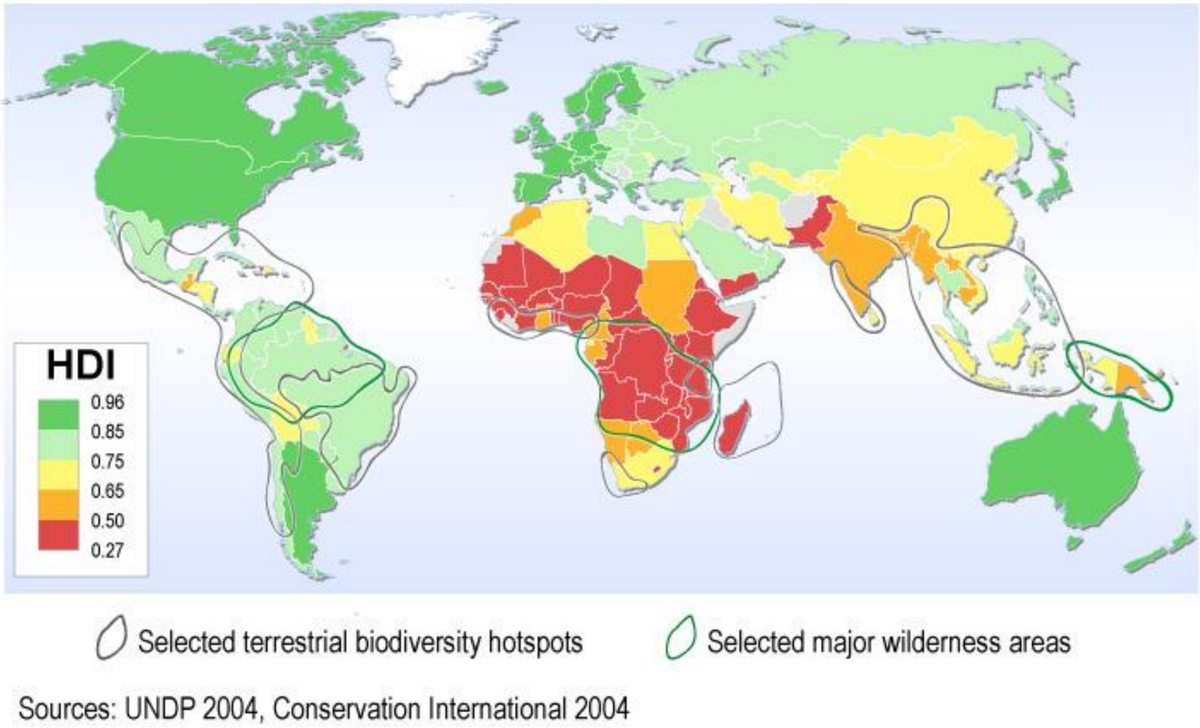

Figure 2: Global biodiversity hotspots and development levels (Source: Slingenberg et al. 2009)

In this study, we propose an innovative framework for ecosystem evaluation that can be a useful input in the debate surrounding ecosystem management. Because of the complex relationship between the underlying causes of biodiversity loss in developing countries, ecosystem management in these regions needs a departure from the business-as-usual CBA model of evaluation. Essentially, such framework needs to recognise the relative multi-faceted needs, pluralistic dimension and the hermeneutic influence of the historical, cultural, social and economic needs of the individuals involved in the evaluation. The starting point of such a framework is to understand the underlying drivers of ecosystem use in the locality (Figure 3).

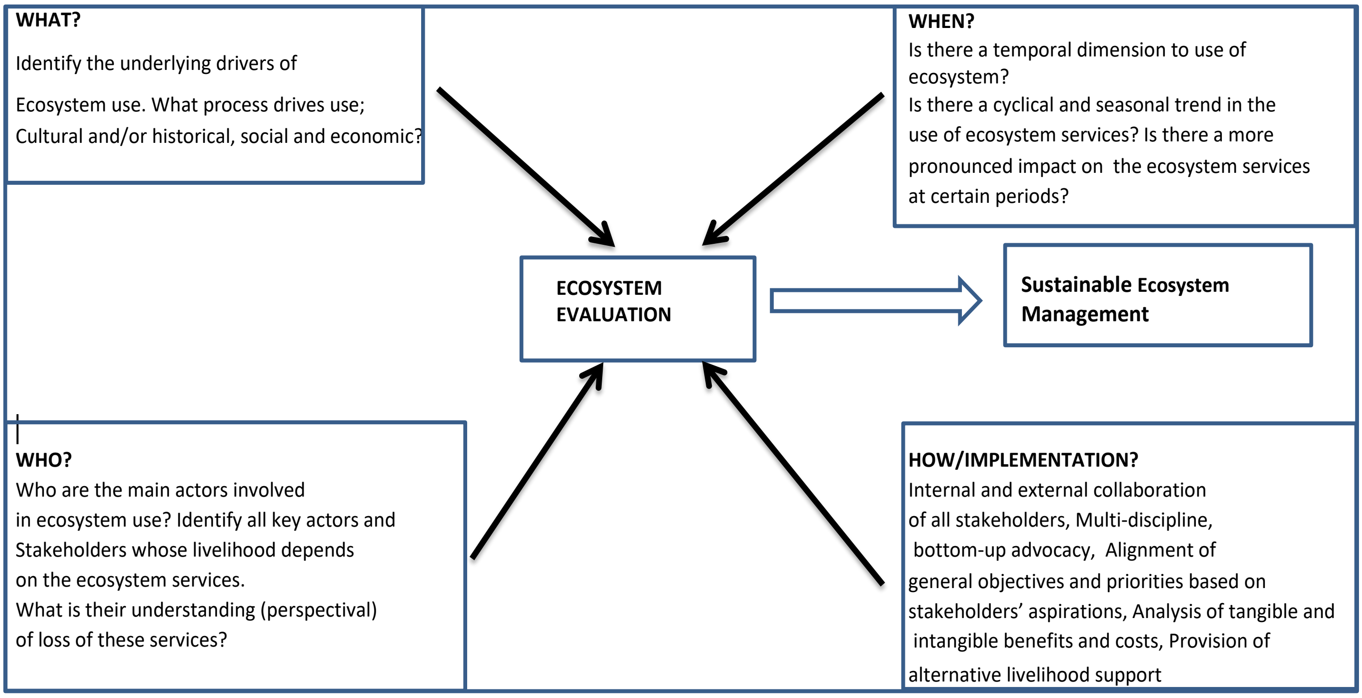

Figure 3: Conceptual framework for ecosystem valuation for sustainable ecosystem management in developing countries

Changes in ecosystem services are almost always caused by multiple interacting drivers (Nelson et al. 2006). These could be cultural, social, and economic and they could interact and work over time. For instance, Geist and Lambin (2004) reveal that these drivers work synergistically, that is each effect being amplified by the combined effect of the multiple drivers through reciprocal action and feedbacks. Identifying these and accounting for the costs and benefits of these drivers is made rather more complicated because of imperfect information and because the services generate significant externalities or market failures. Externalities, in this case, represent the non-priced effect on the welfare of one actor in the economy resulting from the activities of another (market failure).

In addition, there is a spatial and temporal dimension to ecosystem loss. In a related study, Nelson et al. (2006) show that drivers could interact across spatial, temporal, and organizational scales and it highlights how global trends in climate change and/or globalization can influence regional contexts of local ecosystem management. For example, an exogenous shock to cash crop price at the international market can drive export, triggering land-use changes, causing the re-prioritisation of land use and conservation at the local level in developing countries. Agents of cultural, religious and socio-political drivers enter the scenarios in some ways (Menzel and Teng 2010, Norgaard 2010, Seppelt et al. 2011).

Neglecting individuals' socio-cultural values, social needs, perceptions and intertemporal dimensions to preferences in assessments may hinder the social and political relevance of the concept and thus its usefulness to facilitate social change (Bryan et al. 2010, Norgaard 2010, Chan et al. 2012). As opined by Morando-Figueroa *et al.* (2023), the growing attention towards monetary valuation increases the relevance of testing whether such valuation studies capture socio-economic and environmental factors, as they are supposed to. The authors suggests that arid regions are a good case for ascertaining this since their inhabitants have higher vulnerabilities to environmental degradation and the associated loss of ecosystem services required for subsistence whereas for a credible and reliable valuation of ecosytem services, the information garnered must be representative of the area (Woodruff and BenDor, 2016; Schild *et al.*, 2018).

In addition, we need to understand the socio-economic characteristics of the relevant stakeholders at the local level who are involved in many of the underlying causes of ecosystem use. To actively engage the local stakeholders in biodiversity or ecosystem management, one must provide a framework that embeds in it an opportunity for enhanced understanding of what empowers individuals to make choices. For instance, the local actor is most likely acting rationally given his/her set of limits and possibilities, including any social, cultural, political, economic, and environmental constraints applicable (Slingenberg et al. 2009). That is, given a set of choice between satisfying his immediate needs or under discounting future benefits, the local actor will not die of hunger as predicted by the Buridan Ass paradox[1], but rather most likely to elect to fulfil his/her current needs using the available ecosystem components. In such a situation, the argument for allowing conserving the biodiversity might not hold much appeal[2]. More importantly, we need to establish a connection between the stewardship of biodiversity and the interrelationships with individuals in many developing regions of the world many of whom live in the most biologically diverse regions. An effective argument here would incorporate strategies of more sustainable agriculture, one that calls for the practical development of agriculture that provide both crop foods and restored ecosystem services (Ayala et al. 2009).

Finally, to implement ecosystem valuation, one has to inspire a connection among the various stakeholders (internal and external) that reflect a bottom-up approach to advocacy, alignment of priorities and one that meets with local stakeholders' aspirations. The framework for implementation of valuation techniques should be built on a clear and compelling mutually agreed upon message on the importance of biodiversity, the risk from depleting it and the provision of alternative livelihood options for local actors that rely on it for livelihood support. To engage in this regard, therefore, implies developing meaningful connections with others; to bring into association or aid; or to attract, hold, or draw others into some agreed-upon action or service.

Conclusion and recommendations

Achieving the goal 15 as enshrined in the Sustainable Development Goals involves safeguarding the conservation of biodiversity and ecosystem components and ensuring that they meet the immediate and long-term socio-economic needs of current and future generation. This involves developing a framework that encapsulates the actual evaluation of all social and private costs and benefits of ecosystem companies and the services they provide. However, the psychological and interpersonal understanding of human behaviour and the non-linearity of ecological change suggest that the normative foundation of the CBA may be inadequate in understanding and appraising the full benefits and costs of ecosystem services. The theoretical principles that underlie cost-benefit analysis need to accommodate these subtle differences, and

[1] The Buridan Ass paradox refers to a hypothetical situation wherein a donkey that is equally hungry and thirsty is placed precisely midway between a stack of hay and a pail of water will die of both hunger and thirst since it cannot make any rational decision between the hay and water.

[2] Specifically implying that the hungry man or woman is likely to act contrary to the expectations of long term benefits from biodiversity conservation and/or sustainable management f of the environment

indeed, require one that accommodates a higher level of objectivity and specificity while designing the CBA as an informational input for decision making in environmental valuation.

In addition, we show how these complexities are further complicated in many developing countries where there is a complex interrelationship between the stewardship of ecosystem services and the economic, social, and cultural benefits that ecosystem services provide for livelihood activities in many developing regions. Furthermore, the public good nature of ecosystem services and the negative externalities that depletion generates further complicate the estimation and valuation of the costs and benefits associated with ecosystem services. These, we argue, make the conventional accounting of CBA analysis quickly degenerate into a myriad of vexing conundrum that underscores the true value of ecosystem services.

Developing a sustainable framework for ecosystem management involves having evaluation techniques that embed and encapsulate the myriads of possible pluralistic and multi-faceted dimensions of ecosystem services for human livelihood. This we argue involves, first; having a more pluralistic and spatial framework that incorporates inputs across a broad spectrum of related disciplines of learning in social and natural sciences on ecosystem valuation. Second, the need to conceptualise ecosystem services in non-monetary valuation. This could be either by thinking of them as assets or expressing their impact in a language that has a greater universal meaning. The third is recognising the limits of utility maximisation suppositions as for the main behavioural predictor of choices. More importantly, is the recognition that humans tend to behave in ways that deviate from the *Homo economicus* assumptions and display traits that tend to make them fit given the collective interest of the society at large. Finally, we need an implementation framework that establishes meaningful connections with others. Being able to bring out the association or aid, and to attract, hold, and/or draw others into some agreed-upon action or service based on well-defined bottom-up advocacy that meets with stakeholders' aspirations and understanding of the importance of long-term sustainability of ecosystem services.

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