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Understanding the relationships between ecosystem services and poverty alleviation: A conceptual framework

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ABSTRACT

As interest grows in the contribution of ecosystem services to poverty alleviation, we present a new conceptual framework, synthesizing insights from existing frameworks in social–ecological systems science and international development. People have differentiated abilities to benefit from ecosystem services, and the framework places emphasis on access to services, which may constrain the poorest more than aggregate availability. Distinctions are also made between categories of ecosystem service in their contribution to wellbeing, provisioning services and cash being comparatively easy to control. The framework gives analytical space for understanding the contribution of payments for ecosystem services to wellbeing, as distinct from direct ecosystem services. It also highlights the consumption of ecosystem services by external actors, through land appropriation or agricultural commodities. Important conceptual distinctions are made between poverty reduction and prevention, and between human response options of adaptation and mitigation in response to environmental change. The framework has applications as a thinking tool, laying out important relationships such that an analyst could identify and understand these in a particular situation. Most immediately, this has research applications, as a basis for multidisciplinary, policy-relevant research, but there are also applications to support practitioners in pursuing joint policy objectives of environmental sustainability and poverty alleviation.

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1. Introduction

Much policy momentum and research effort currently surrounds ecosystem services: the 'benefits people obtain from ecosystems' (MEA, 2005; v). This anthropocentric approach to nature promotes new thinking about the contribution of the environment to human wellbeing (Costanza et al., 1997; Daily and Matson, 2008). One area highlighted, but not extensively developed by the Millennium Ecosystem Assessment (MEA, 2005), directed attention towards the particularly significant contributions of ecosystem services to the wellbeing of the global poor, whose livelihoods are often directly dependent on services (Daw et al., 2011; Fisher, 2004; Cavendish, 2000). A focal point is developing, representing a coincidence of agendas between an environmental community seeking to broaden constituencies for sustainability (Roe, 2008), and the development community, responding in part to the changing characteristics and distribution of global poverty (e.g. Sumner, 2012; Chen and Ravallion, 2007; Wade, 2004), to become increasingly focused on the poorest (White and Anderson, 2001; Department for International Development, 2011). This field is now the focus of significant research effort (e.g. see ⟨www.espa.ac.uk⟩), and emerging policy attention, demonstrable, for instance, in policy initiatives around Payments for Ecosystem Services and Ecosystem-Based Adaptation.

To further the research agenda forged by the MEA, and assist with understanding linkages between ecosystem services, human wellbeing, and poverty, we present this Ecosystem Services and Poverty Alleviation (ESPA) conceptual framework. A brief note is required at this stage on definitions. We define ecosystem services in line with the MEA (2005) and elaborate in Section 2 how our conceptual framework advances these concepts. Our definition of poverty draws extensively from the 'Voices of the Poor' research (Narayan et al., 1999), and in turn the MEA (2003): human wellbeing is defined with reference to five components: basic material for a good life; security; health; good social relations; and freedom of choice and action. In turn, poverty and derivatives

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including 'poor' are defined as the deprivation of wellbeing (MEA, 2003; Narayan et al., 1999). A more comprehensive discussion of poverty alleviation can be found in Section 2.

By its nature, research in this field requires multidisciplinary collaboration, for which integrative conceptual frameworks are useful to make sense of complexity (Ostrom, 2009; Diaz et al., 2011). This framework builds on a review of existing frameworks used in the environmental and social sciences (Fisher et al., 2013) synthesizing insights from various disciplines such that this multidisciplinary research agenda will be better integrated and better conceptually supported. There are also policy applications, analogous to those of the Sustainable Livelihoods framework, in which the framework could be used by community leaders, government agencies, and NGOs, potentially in a participatory manner. The framework is specified for applications in developing country situations characterized by subsistence dependence on ecosystem services, and poverty. Whilst the applications are more obviously rural, the framework is also applicable to urban situations, an emerging research agenda (Ernstson et al., 2010; Elmqvist, 2011a). It is important to note here that whilst we focus on ecosystem services, we do not seek to overstate their importance. Clearly many factors, including access to healthcare and education, and freedom from conflict, also foster wellbeing, and their claims to long-term reduction of poverty may actually be more robust than claims surrounding ecosystem services.

This ESPA framework has been influenced by two fields that rely on frameworks in distinct ways. In international development, frameworks are commonly used as tools for analyzing situations or policy approaches. They tend to represent checklists, which are generally not enumerable. In developing this, we have also drawn upon social–ecological systems (SES) research. Here, frameworks tend to be represented diagrammatically, and may serve the purpose of conceptualization of a dynamic system as the precursor to an enumerated model.

Influenced by SES research, we present this framework diagrammatically, having previously noted the value of meaningful relationships between components, compared to checklists (Fisher et al., 2013). However, we anticipate that the translation of this to an enumerated model would not be straightforward because many elements are fundamentally qualitative. There are further benefits of considering the interaction between ecosystem services and poverty alleviation through an SES lens: such analyses can support the integration of natural and social sciences, and are associated with complex systems science and ideas of dynamism, non-linearity, uncertainty and thresholds (Janssen and Ostrom, 2006b). Because these are properties of the systems and situations we study (Carpenter et al., 2009; Rounsevell et al., 2010), SES approaches are useful. However as yet, systems approaches have little capacity for integrating analyses of power and politics (Cote and Nightingale, 2011), or human agency (Brown and Westaway, 2011). With a degree of novelty, this framework supports analysis of the political economy of access to and appropriation of ecosystem services.

The framework has also been influenced by development studies, where a number of factors promote frameworks. Development is policy-applied and inherently cross-cultural and development professionals are often required to travel to unfamiliar places to gather information and provide analysis. Frameworks are popular for these reasons: they provide a checklist, something to work from when a development professional walks in to a village. Sustainable Livelihoods (Scoones, 1998), for instance, is a tool that can be fruitfully applied to analyse most situations in the developing world, regardless of prior familiarity. It is not incidental that this framework developed from an intellectual tradition that had previously identified structural problems in the professional practice of development. Chambers wrote about the biases of 'development tourism': that professionals rarely visit remote communities, or travel during the wet season, tend to interact with the comparatively wealthy and powerful, and visit showcase villages and projects (Chambers, 1983). In such situations it is easy to overlook factors that are not immediately obvious, but may be nonetheless important. Comprehensive frameworks such as this one make things harder to overlook, but may also foster a lowest common denominator approach (Clark and Carney, 2008). Frameworks are powerful because they dictate what is on the agenda. This leads to a central limitation: if frameworks are used mechanistically or uncritically, they can hinder a deeper, questioning analysis, that remains open, for instance, to factors that do not feature in the framework (Carney, 2003).

2. A framework for analysing ecosystem services and poverty alleviation

Generic and comprehensive frameworks such as this are valuable as thinking tools to apply to a situation, for identifying important processes and detailing their character. Reardon and Vosti (1995) argue that studies of the poverty/environment nexus have tended to be too general in both areas, and hence context-specific analyses are important within this field. However, incorporating more contextual information will often mean dealing with higher levels of complexity. Compared to the MEA framework, this ESPA framework is larger and more complex; it unpacks the services/wellbeing nexus, supporting a systematic understanding of complexity. Ostrom (2009) argues that we should strive to understand the component parts of complex wholes, methodically dissecting the complexity, rather than artificially simplifying it.

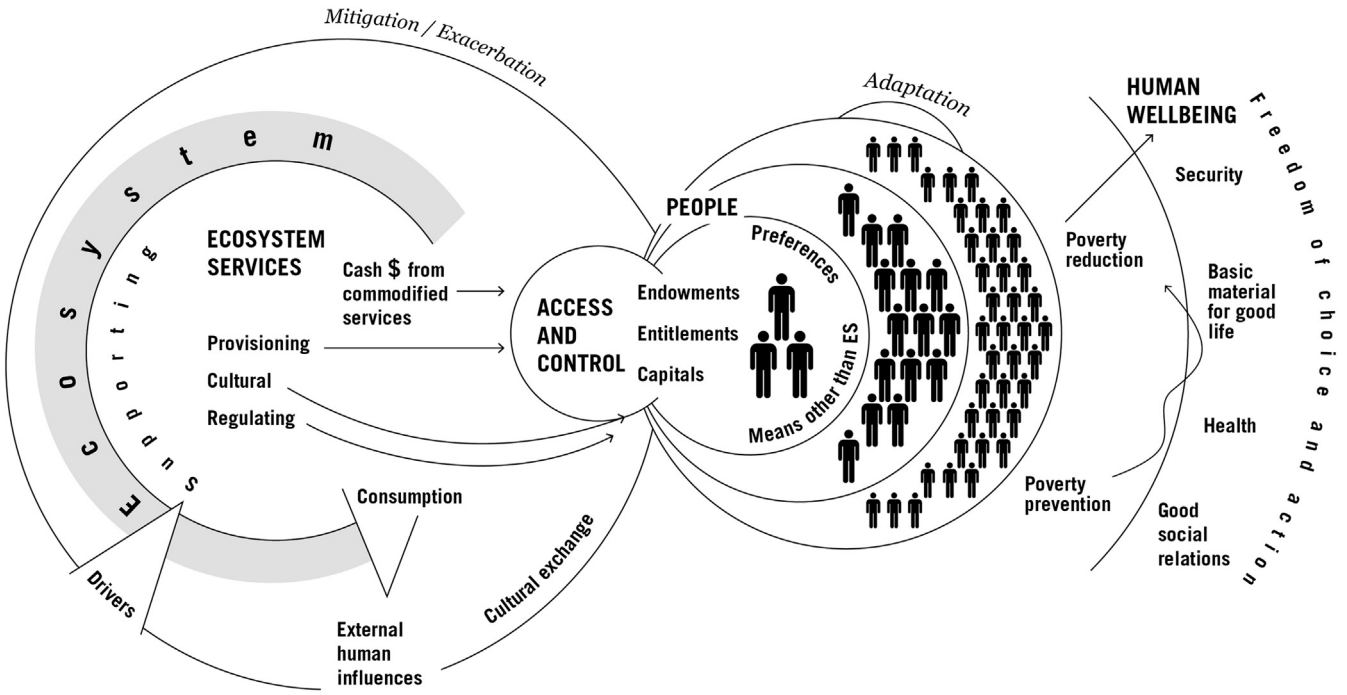
Fig. 1 displays the diagrammatic framework representation. What follows is an expanded explanation of the framework with examples from diverse geographies, chosen solely for their illustrative capacity. The next section is structured to consider firstly ecosystems, the services they provide, and poverty alleviation. Central to the contribution of ecosystem services to wellbeing are considerations of social differentiation and whether people can access services, and this discussion therefore takes a prominent position. We then build outwards, noting innovations. The final section discusses potential applications and limitations of this ESPA framework.

2.1. The ecology of the framework

The ecosystem forms the foundation of the framework, comprising the set of biophysical processes and structures producing ecosystem services, used by people to support their wellbeing, as depicted in the rightwards progression of Fig. 1. We use Tansley's (1935) ecosystem definition (defined in Fig. 1), which encompasses the role of dynamic processes, and crucially, is scalable, meaning it can be defined according to the application, such that the ecological scale matches the social scale of focus. Whilst the framework is fundamentally anthropocentric, this section briefly discusses key ecological properties governing service provision, focusing upon ecological function, diversity, resilience and thresholds.

Ecological function describes the workings of ecological processes, such as the fluxes of energy and mass (carbon, nutrients) through an ecosystem. These functions directly support provisioning, supporting and regulating services, through transformations of matter and energy. However, such biogeochemical processes do not directly support cultural services, which are emergent properties of ecosystems, for instance, linked to flowering or ecosystem characteristics perceived by people as wild.

Some recent debate in the ecological literature surrounds the role of diversity, particularly biological diversity, in determining



An **ecosystem** '…includ[es] not only the organism-complex, but also the whole complex of physical factors forming what we call the environment' (Tansley, 1935; 299).

Ecosystem Services are 'the benefits people obtain from ecosystems' (MA, 2005; v).

Access and control form the social and political dynamic through which people interact around ecosystem services.

People are represented at different scales. They are differentiated by characteristics (endowments, entitlements, capitals, preferences and means other than ecosystem services), influencing their ability to access and control ecosystem services.

Human wellbeing incorporates material, health and security factors, good social relations and freedom of choice and action (from Narayan et al. 1999; 2000, adopted by MEA, 2005).

Poverty alleviation is composed of **poverty reduction**, a process by which people move above a notional poverty line, and **poverty prevention**, the maintenance of a minimum standard of living with immediate needs met, below a notional poverty line (Angelsen and Wunder, 2003; 2).

Drivers are 'natural or human-induced factors that… unequivocally influence ecosystem processes' (MA, 2005; 64).

External human influences are anthropogenic influences originating beyond the people sector.

Through **mitigation** or **exacerbation**, people (respectively) reduce, or increase drivers.

Adaptation is a process of 'deliberate change in anticipation of, or in reaction to, external stimuli and stress' (Nelson et al., 2007; 395).

Cash from commodified services represents income gained from selling ecosystem-derived commodities, through conventional commodity markets, or more novel payments for ecosystem services.

Consumption represents the removal of ecosystem services by external human influences.

Cultural exchange represents the interaction between people and external human influences, for instance through technology transfer.

Fig. 1. The conceptual framework.

ecological function, resilience, and the provision of services. Work addressing this 'grand challenge' in ecology has tended to be experimental and focused at relatively small scales, from microcosms to field-scale trials; it is therefore hard to translate to human scales (Tilman et al., 2001; Naeem et al., 2009; Isbell et al., 2011). More recently, large-scale observational studies have also emerged (Paquette and Messier, 2011), and review papers investigate the relationship between diversity and ecosystem services (Balvanera et al., 2006; Isbell et al., 2011). In a meta-analysis of published research ($n=103$), a clear positive association is demonstrated between biodiversity and the delivery of most services (Balvanera et al., 2006). However, complex time and space relationships exist between biodiversity, ecosystem functioning and ecosystem services, which are not well enough understood to facilitate robust predictive modeling (Norgaard, 2010).

There are also complexities in the relationship between ecological resilience and ecosystem services. In ecology, resilience is specified as 'the speed with which a community returns to its former state after it has been perturbed and displaced from that state' (Begon et al., 2006; 586), whilst a second important property, resistance, 'describes the ability of the community to avoid displacement in the first place' (Begon et al., 2006; 586). This distinction is important because more diverse communities may lack resistance while maintaining high resilience (Pfisterer and Schmid, 2002). Applying these ideas to ecosystem services, low resistance implies vulnerability of services to shocks, while low resilience implies slow recovery in service provision.

It is hypothesised that with declining diversity comes declining ecological function and declining provision of a range of services, until some threshold is met, depending on resistance. The ecosystem then shifts to a new impoverished functional state from which recovery is difficult or impossible, depending on resilience. This has been observed in coastal ecosystems when cascading ecological effects follow predator removal (Estes et al., 1998). Ideas of biophysical thresholds or 'tipping elements' have been applied to the interaction of multiple anthropogenic perturbations to the earth system and the threats these pose to SES at different scales (Lenton et al., 2008). Reflecting such concerns, the concept of resilience in SES, defined by Walker et al. (2004), and incorporating ideas grounded in ecological resilience and resistance, has risen in prominence as a lens for understanding not solely ecological, but whole-system behaviour in response to disturbance. Research and policy applications of the framework are likely to take an interest in whole system resilience. This will involve assessing interacting responses to perturbation in different components of the framework.

Having discussed ecological properties governing services provision, we turn to ecosystem services. This framework employs the MEA's four-part categorization of ecosystem services: provisioning; regulating; supporting; cultural. This is a widely employed and flexible categorization, although critique has been leveled that it fosters double-counting in valuation (Costanza, 2008; Fisher et al., 2009). Our framework uses the MEA categorization because it is not intended to support economic valuation of services; frameworks such as The Economics of Ecosystems and Biodiversity (TEEB, 2010) or UK National Ecosystem Assessment (NEA, 2011) are better suited for this, with a terminology of ecosystem services precisely for valuation (Mace et al., 2012).

Whilst the MEA nominally links every category of service with every component of wellbeing[1], this ESPA framework allows the analyst to establish which ecosystem services feature in the particular situation, how they contribute to wellbeing, and which may be priorities. For instance, Brown et al. (2008) find that the coastal poor tend to prioritise provisioning and regulating services. We suggest typical associations between services and wellbeing, but caveat what follows with caution that these are generalized logical relationships, when in reality, wellbeing is highly contextual. Material wellbeing tends to depend primarily on provisioning services and secondarily on supporting and regulating services; health follows this pattern, with cultural services playing a more tangible role, through their contribution to social wellbeing, identity and mental health. Similarly, good social relations relate to all categories of services, with cultural services playing a heightened role. Physical security results primarily from regulating services, with supporting and provisioning services also important. As in the MEA, 'freedom of choice and action' overarches all of these, because wellbeing is derived from the exertion of choice (cf. Narayan et al., 2000; Sen, 2001).

A note is also required about ecosystem 'disservices' (Dunn, 2010), environmental factors that harm human wellbeing. As Dunn (2010) notes, the lack of emphasis on these, including in the MEA (2005), is surprising. Most disservices take the form of direct harm from dangerous animals, or disease as a regulating disservice (Dunn, 2010). Direct harm is associated simply with exposure, through proximity or vocation. Regulating disservices follow pathways through the framework similar to regulating services, but result in detriment to wellbeing, rather than benefit.

2.2. Poverty alleviation and human wellbeing

As outlined above, we consider that poverty alleviation leads to increased wellbeing. The presentation of these wellbeing components (derived from the MEA (2003) and Narayan et al. (1999, 2000)) are deliberately generic such that a user of the framework could specify their own interests and/or metrics for poverty. Similarly, the framework could be used in an inductive manner, to establish how people construct their own wellbeing (cf. Coulthard et al., 2011) in a particular situation.

Following Angelsen and Wunder (2003), the framework distinguishes different types of poverty alleviation. Poverty reduction is defined as a process by which people move above a notional poverty line (Angelsen and Wunder, 2003), for instance based on Human Development Indicators. In contrast, through poverty prevention, people maintain a minimum standard of living with immediate needs met, although they may be below a notional poverty line (Angelsen and Wunder, 2003). This distinction is significant because ecosystem services are just as, if not more, likely to be associated with prevention than reduction (Angelsen and Wunder, 2003; Mayers, 2007; Fisher et al., 2013). It is worth noting here that the two pathways indicated in Fig. 1 are simply indicative: any poverty trajectory is possible, including poverty exacerbation.

In preventing poverty, forest products tend to fulfil the role of safety nets and gap fillers (Angelsen and Wunder, 2003; Mayers, 2007). Fisher (2004) explores the contribution of forests to livelihoods in Malawi, illustrating the distinctions between reduction and prevention. Fisher distinguishes between high- and low-return forest activities in their contribution to wellbeing. Forests generally prevent poverty for households whose activities are limited to low return forest activities e.g. sales of crafts, food, drink, firewood and bamboo, roof thatching, brick burning, and traditional medicine. Forests may reduce poverty for households able to engage in forest livelihood activities with higher returns (charcoal/timber/forest employment). Policies which focus on maintaining access by the poor to low return activities in the absence of other interventions, may only prevent poverty (Fisher, 2004; cf. Kulindwa et al., 2010 in Tanzania). Having established core concepts at either end of the framework, the discussion now moves to concepts that mediate the relationship between ecosystem services and poverty alleviation.

2.3. Social differentiation

In developing countries, poor rural people have historically been, and are still commonly, portrayed as the most significant environmental threat (Agrawal and Gibson, 1999; Hulme and Murphree, 1999; Attwell and Cotterill, 2000; Brockington et al., 2006). Recent work that demonstrates the displaced impacts of higher consumption lifestyles (e.g. DeFries et al., 2010; Weinzettel et al., 2013), including within rural developing country communities (Cavendish, 2000), have served to challenge this portrayal. In addition, the anthropocentric premise underlying the concept of ecosystem services may allow some reconceptualisation of the place of people in nature, moving beyond paradigms of fortress conservation and exclusion of people from livelihood resources. It may also permit a focus upon how ecosystems might be managed to maximize the services they provide to impoverished people.

Hence, the main innovation of our framework is to develop this anthropocentric premise of ecosystem services concepts, to focus on people, their characteristics, and their ability to access services. This approach stands in contrast to frameworks including MEA and TEEB, which present disembodied wellbeing: outcomes without agents (see Fisher et al. (2013) for a more detailed review of frameworks).

Inherent to the central representation of people is the way this provides for analysis of social differentiation, drawing from work on environmental entitlements, political ecology and social vulnerability (Fisher et al., 2013). This is a prerequisite for a focus on the poor, and a central innovation of this framework; the MEA framework was limited without this recognition (Daw et al., 2011). In the framework presentation, people are differentiated by scale, and through characteristics influencing their access to services.

2.3.1. Scale

An important design feature of the framework is its incorporation of scale. That the framework does not pre-suppose a scale means it is suitable for application at various scales. Because of its emphasis on social differentiation at an intra-community level, it is most obviously applied at the community scale, although other scales from the household upwards, could also be analysed. The group of interest should be defined first, for instance, for an analysis focused on the poorest, or on women or men. Key processes relating to that group can then be identified and understood, and parts of the analysis repeated in relation to another group, if relevant. Scholars highlight the importance of cross-scale dynamics (Adger et al., 2006, Cash et al., 2006, Romero and Agrawal, 2011), and the framework supports analysis of these. In Fig. 1, groups of people at different scales interact through the access and control sector; this shows that groups are instrumental in controlling the access of other groups. For instance, community level institutions relating to common property resources may restrict the access of households to particular ecosystem services. At a larger scale, states impose environmental restrictions on communities. The framework also supports analysis of the appropriation of ecosystem services through globalised channels.

[1] The MEA framework does qualify these links in relation to 'intensity' and 'potential for mediation by socioeconomic factors' (MEA, 2005; vi).

2.3.2. Characteristics of people

We use the term characteristic for factors that affect people's ability to access and benefit from ecosystem services. Here, we integrate an important tenet of social–ecological thinking; an ecosystem service is defined as much by the characteristics of those people benefiting from the service, as it is by the ecology underpinning the service (Rounsevell et al., 2010). This section starts by focusing on the basis by which people are differentiated, according to the characteristics presented in Fig. 1, of:

- Endowments and entitlements
- Capitals: natural, social, human, financial, and physical (which we consider includes technologies).
- Preferences
- Means other than ecosystem services

The following section illustrates each characteristic, showing how this differentiation affects access to ecosystem services. Endowments, entitlements and capitals are instrumental in governing access, meanwhile human preferences affect the ecosystem's character in human-dominated landscapes. Means other than ecosystem services reflects the fact that other, non-environmental factors contribute to wellbeing. While the language of characteristics and capitals tends to imply relative stasis, on the contrary, these factors may be relatively dynamic. Thus, in applications of the framework, attention must be paid to dynamics and trends in each characteristic. Furthermore, the very framing of these as characteristics is relatively reductionist and may detract from the structural societal processes perpetuating marginalization and poverty. Applications of the framework can therefore seek to ask questions about why these characteristics prevail, as well as how they are manifest.

2.3.3. Endowments and entitlements

Fisher et al. (2013) draw upon previous work on environmental entitlements (Leach et al., 1999; Sikor and Nguyen, 2007) to highlight the importance of endowments and entitlements in the differentiated access of people to ecosystem services. Endowments are the 'rights and resources actors have' (Leach et al., 1999; 233). Endowments can be natural, for instance, proximity to a forest, or legal, including statutory rights to forest products. Endowments are distinct from entitlements, which are the means to use a resource: 'legitimate effective command over alternative commodity bundles' (Leach et al., 1999; 233). It may be useful to think about endowments as what can be given (for instance, by a state to its citizens), and entitlements as what can be done with an endowment.

The example presented by Leach et al. (1999) on the use of *Marantaceae* plants in Ghana is instructive. These leaves are commonly used for wrapping food. The structure of *Marantaceae* endowments depends on whether they lie inside or outside state-reserved forest. Off-reserve, these are village common property, subject to local level institutions, and in reserves, they are subject to government permits (Leach et al., 1999). Once endowed with the leaves, people leverage entitlements to harvest these, then use them directly or sell them for income. Thus, labour, marketing ability and networks are all important in how people derive wellbeing from *Marantaceae* (Leach et al., 1999).

Sikor and Nguyen (2007) use entitlements analysis in Vietnam to understand the consequences of forest devolution for the poor. They show how endowments have been increased in a relatively egalitarian manner. Yet entitlements to ecosystem services, in this example timber, depend on household labour and financial capital, which are highly differentiated within communities. This shows the value of a distinct treatment of endowments and entitlements (Sikor and Nguyen, 2007), which is maintained in this ESPA framework. Because endowments, and to a greater extent entitlements, vary between people, and are dynamic through time, they are a key factor in social differentiation. Because of this centrality in governing access to resources, endowments are often highly contested.

2.3.4. Preferences

Another important human characteristic that mediates the relationship between wellbeing and ecosystem services is that of preferences. We tend not to think of preferences in relation to poverty, as lack of choice characterizes poverty (Narayan et al., 2000; Sen, 2001). However, ecosystems reflect people's preferences and are extensively managed and manipulated, another reason supporting their characterization as SES. Within such systems, the composition of species, particularly plants, reflects human preferences. Because different groups have different priorities, this composition may be contested within communities (Springate-Baginski and Blaikie, 2007). Beyond shaping the composition of the ecosystem, people draw on ecosystem services differentially according to their preferences. An example comes from Nepal: a blacksmith might select for hardwood species suitable for charcoal, women may prefer fodder trees, and religious families might select for religious plants (Ojha et al., 2003). These differing priorities may be based on wealth: in Sishwar community forest, poorer groups depend on vokta (*Eulaliopsis binata*) for making rope, and select for this in the forest. In contrast, richer households are able to afford plastic ropes and tend to eliminate this species as a weed, to the detriment of the poor (Neupane and Ojha, 2002). Power differentials between social groups are therefore manifest in the species composition of forests. Representing these ideas, the framework shows that ecosystem composition and the services accessed from ecosystems reflect people's preferences.

2.3.5. Capitals

The Sustainable Livelihoods framework (Scoones, 1998) highlights the role of capitals (financial, human, natural, physical, social) in rural development. We present these capitals as characteristics, held by individuals and groups. We discuss and illustrate these in terms of how they mediate access to ecosystem services.

Physical capital comprises the infrastructure and physical goods that support livelihoods. We discuss this in the same entry as technologies, because together these are critical for harvesting ecosystem services. When physical capital and technologies are distributed unevenly within communities, there will be differentials in access to ecosystem services. In empirical work in coastal areas of Kenya, Brown et al. (2008) highlight the importance of technology, for instance motorized boats, in access to services. Fishers tend to see lack of technology as a significant constraint, preventing access to certain species and fisheries (distant or deep-sea), and preventing increased income, or conservation of fish stocks (Brown et al., 2008). Diverse geographical examples help to further illustrate the importance of technology. In Nepal, timber extraction requires more physical capital investment and is therefore disproportionately available to wealthier people (Ojha et al., 2009). In rural Western Uganda, the harvesting and preparation of timber is the role of men, who own and maintain the technology, and, within the household, tend to control benefits from timber (Fisher, 2011). This example highlights the possibility of gendered differentials of access to ecosystem services manifest within the household. The framework could be applied at this micro scale, if appropriate to the application.

In Nepal, 69% of households use firewood, a provisioning service, as their main source of fuel (Pokharel et al., 2009). More

than one million hectares (approximately one third) of forests in Nepal are under some form of community management (Pokharel et al., 2009), and the regulation of fuelwood in community forestry tends to be relatively egalitarian, lacking socially-differentiated rules of use (Thoms, 2008). However, because management of community forests has tended to promote conservation (Larsen et al., 2000; Malla et al., 2003; Yadav et al. 2003; Thoms, 2008), fuelwood allowances, although egalitarian, are restricted. In some areas, people have to purchase additional fuelwood and other forest products beyond their allowance (Thoms, 2008). To meet additional fuelwood requirements, financial capital clearly becomes important, and the monetarily poor may suffer from lack of fuelwood access.

Social capital is the 'shared knowledge, understandings, norms, rules and expectations about patterns of interactions that groups of individuals bring to a recurrent activity' (Ostrom, 2001; 176, drawing upon Coleman, 1988; Ostrom, 1990; Putnam et al., 1993). Whilst challenging to appraise empirically, social capital is considered central in development (Narayan, 1998; Putnam, 2000), although Fine (1999) argues the concept has been overstretched, particularly in the World Bank's uptake. Social capital is important in overcoming a range of dilemmas and collective-action problems surrounding natural resources (Ostrom, 2001), and adapting to environmental change (Adger, 2003). Bebbington (1999) argues that social capital encompasses the capability to access resources and enhance livelihood security, and it therefore strongly influences access to ecosystem services. It plays a central role in farmer irrigation systems in Nepal, determining how the critical ecosystem service of water is distributed within a community. Ostrom (2001) shows how locally-governed irrigation is better maintained, delivers more water to the tail-end and is associated with more equitable outcomes than systems designed by the national agency. She attributes this to the evolution of locally-governed systems informed by social capital, whereas development interventions tend to focus on physical capital investments, without accounting for social capital (Lam, 1998; Ostrom, 2001). This example demonstrates the role of social capital in irrigation function, and for equitable water distribution. However, social capital may or may not support equity or pro-poor outcomes. For instance, hierarchical norms in Nepali society may work against egalitarian decision processes and equitable outcomes in community forestry (Thoms, 2008).

Human capital, 'the acquired knowledge and skills that an individual brings to an activity' (Ostrom, 2001; 175) is also important in how individuals access ecosystem services (Paudyal et al., 2006; Thoms, 2008). As with social capital, human capital differentials have implications for representation in groups controlling resource access. Community forestry user groups in Nepal have to maintain forest inventories, requiring numeracy, literacy and special training (Thoms, 2008). Those engaged by forest officials therefore tend to be local elites, educated and higher caste. The disproportionate representation of elites in user groups prevents pro-poor management, reflected for instance in species grown, or access arrangements.

2.3.6. *Achieving wellbeing through other means than ecosystem services*

The final characteristic of people highlighted by this framework is the ability to achieve wellbeing through means other than ecosystem services. Few circumstances are imaginable in which wellbeing is derived exclusively from ecosystem services. Other elements, for instance, education, healthcare and energy, are also critically important.

To illustrate the point that means other than ecosystem services can be important for wellbeing, we consider different sources of energy. Links between access to energy and human wellbeing are extensively documented in Narayan et al. (2000), Wilkins (2002) and UNDP (2005). The idea that ecosystem services contribute to poverty alleviation is challenged in one respect, when we consider that ecosystem services provide relatively diffuse fuel sources (e.g. biomass including wood, dung, charcoal). Because they are diffuse, they are often time-consuming to harvest, and have respiratory and other health costs if burnt in poor ventilation, these burdens often being borne disproportionately by women (Wilkins, 2002; UNDP, 2005). Hence, there is a negative association between dependence on ecosystem service fuel sources and prosperity (Wilkins, 2002), displayed in Fig. 2. People can achieve higher levels of wellbeing if they do not depend on ecosystem service energy sources: concentrated energy supports many aspects of wellbeing, including 'access to water, agricultural productivity, healthcare, education, job creation' and income diversification (UNDP, 2005; 2). In the industrialized world, direct dependence on (particularly) provisioning services is substituted through technology and more concentrated energy sources. Raudsepp-Hearne et al. (2010) discuss this in relation to the 'environmentalist's paradox', the idea that wellbeing continues

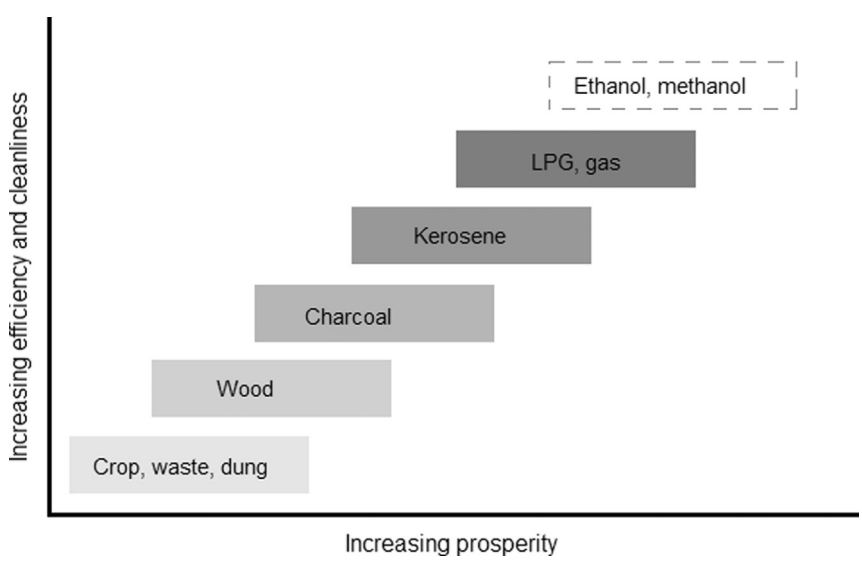


Fig. 2. Relationship between fuel usage and poverty (from Energizing the Millennium Development Goals: A Guide to Energy's Role in Reducing Poverty, by UNDP, copyright 2005 United Nations. Reproduced with the permission of the United Nations.).

to rise globally, as ecosystem services are degraded. Understanding how people balance ecosystem services with other means of achieving wellbeing will therefore be a critical part of any application of the framework.

2.4. Access to, and control of, ecosystem services

Linked to the notion that people have differentiated characteristics, Fig. 1 highlights the importance of access to, and control of, ecosystem services. Following Ribot and Peluso (2003), we describe the social processes governing access as control. Together, access and control form the, often contested, dynamics through which people interact around ecosystem services. These elements are absent from the MEA framework, which instead highlights drivers, associated conceptually with limited aggregate availability of services. Informed by political ecology and the work of Sen (1981) and Leach et al. (1999), we contend that the access/control dynamic is in many cases more important than aggregate availability, particularly from the perspective of the poorest. That said, wellbeing is sometimes constrained by limited aggregate availability of services, and this will be increasingly common as natural resource constraints increase (Rockstrom et al., 2009).

The following examples illustrate dynamics around access, which relate to people's characteristics, as described above. Many of these characteristics are proxies for poverty, and the discussion reflects this. In Tanzania and Nepal, forest management is relatively devolved, altering access arrangements. McDermott and Schreckenberg (2009) report that poorer people tend to be underrepresented in Tanzanian village natural resource committees, and consequently rarely involved in forest income-generation (from timber, for instance) and may be precluded from accessing ecosystem services. The poorest may also suffer disproportionately from restrictions on the expansion of agriculture into forest areas (Schreckenberg and Luttrell, 2009). Such changes in representation and access may increase inequality within communities, leading McDermott and Schreckenberg (2009) to question the pro-poor credentials of community forestry. Remarkable similarities are found in institutional arrangements for community forestry in Nepal (Gilmour and Fisher, 1991; Maharjan, 1998; Brown et al., 2002). This illustrates how controls on ecosystem service use, from within or beyond the community, commonly constrain access, possibly with particularly adverse implications for the poorest, if their interests in the forest contrast to those of other groups (Lund, 2008).

Pertinent questions arise here about what constitutes appropriate levels of access for maintaining ecosystems to support human wellbeing in the long term. Various authors (e.g. Larsen et al., 2000; Malla et al., 2003; Yadav et al., 2003; Thoms, 2008) identify a bias towards protection in Nepalese forest policy, partly perhaps associated with crisis narratives of the 1970s (Eckholm, 1976). This bias means that communities are able to harvest dead, fallen trees and leaf litter, but rights to extract further renewable forest products are typically set lower than the forest could sustain.

The framework highlights differences between services in how they are accessed and controlled. A core distinction exists between those ecosystem services that are physical entities (provisioning and cash derived from services), and a second group including regulating, cultural, and supporting services. As presented diagrammatically, physical entities travel through tangible and well-understood chains of production, often as commodities (raw materials or agricultural products that can be bought and sold). Crucially, this makes them more susceptible to control. The maintenance of regulating, supporting and cultural services tends to be influenced by larger spatial scales, more diverse sets of actors, and more complex ecologies (Fisher et al., 2013), and these factors make them harder to control.[2] Various research frontiers exist in understanding the production of these services and their relationships with human wellbeing.

The framework supports understanding of how people benefit from cash from commodified services, compared to direct services. Income can be derived from selling commodities, either through conventional commodity markets, or through more novel payments for ecosystem services (PES). As there does not yet exist a well-established conceptual framework for understanding social aspects of PES (although definitional frameworks include Wunder, 2005; Sommerville et al., 2009), this represents a further contribution of the framework.

We present cash benefits from ecosystem services separately from direct benefits as these follow quite distinct pathways, with a different means of benefit. Daw et al. (2011) argue that the MEA (2005) synthesis downplayed the importance of employment and cash benefits, focusing instead on direct benefits from ecosystem services. In contrast, empirical work in coastal communities notes that people prioritise cash from the sale of ecosystem products (Brown et al., 2008). By presenting the access pathway for cash distinctly in the framework, we highlight that people draw on different mechanisms of entitlement to benefit from cash streams than they do to benefit from direct ecosystem services. Concepts of environmental entitlements and property rights are usefully applied to understanding benefit streams from commodified versus non-commodified services. Households with land endowments (implying collective-choice rights (Schlager and Ostrom, 1992)) are more likely to be able to access payments. In contrast, poorer people, if they have access, will tend to rely directly on non-commodified services, more likely through 'access and withdrawal', or 'management' rights (Schlager and Ostrom, 1992), than through higher order collective-choice rights. Furthermore, those with only operational rights may lose access to the resource when the service is commodified, particularly in 'use-restricting' (as opposed to 'asset-building', Wunder, 2007) schemes. This all serves as caution against assuming that, on the establishment of PES, those who benefit from uncommodified services will automatically benefit from payments for commodified services. Instead, we must pay attention to the mechanisms of entitlement for different ecosystem services. Thus, in the framework, and through the discussion below, concepts are presented for analysing PES, as one distinct stream of benefits from services. Placing this policy intervention as it stands in practice, in a context of direct benefits from uncommodified services, allows for a more holistic understanding of the implications of payment schemes. This makes clearer the trade-offs between gains in wellbeing from payments, versus possible losses of access to direct services that payments are contingent upon.

The distinction between how people access monetary benefits versus direct services benefits is pertinent to current debates around the policy mechanism Reducing Emissions from Deforestation and Degradation (REDD+). Springate-Baginski and Wollenberg (2010) highlight questions around how the poor might leverage entitlements to benefit from REDD+. Expectations that poorer groups will not benefit derive from experience that natural resources that increase in value tend to be appropriated (Nelson and Agrawal, 2008; Sandbrook et al., 2010; Cotula and Mayers, 2009). In countries including Cameroon, Indonesia, Malaysia and Papua New Guinea, access to forested land tends to be grounded in customary recognition (Cotula and Mayers, 2009). When rights are

[2] Access to cultural services may be relatively easily controlled when the service is closely associated with a particular place, and when property rights allow exclusion and/or a fee is applied. Whilst the general point about regulating, cultural and supporting service stands, the ability to control these may develop as these are commodified through PES.

not formalized, new ecosystem services governance regimes may not recognise, or may even displace those rights. Situations such as these could be analysed with the framework, with attention to how entitlements and other characteristics enable groups to secure access to differentiated ecosystem services, and their monetary benefits, and how these processes relate to poverty and wellbeing.

2.5. Drivers and external human influences

This ESPA framework draws upon and develops concepts from other frameworks to support understanding of anthropogenic changes in ecosystems and ecosystem services. Two key aspects distinguish how we use driver-related terminology. Drivers here are akin to the MEA direct drivers[3]: 'natural or human-induced factors that….unequivocally influence[s] ecosystem processes' (MEA, 2005; 64). Yet, in contrast to the MEA framework, which presents drivers acting upon services, we place more emphasis on the role of drivers in changing the actual ecosystem. In addition, we substitute the term 'external human influences', for what the MEA terms indirect drivers. This makes their anthropogenic character more explicit,[4] and this positioning highlights agency: the consumption choices of people in the industrialized world have far-reaching consequences for ecosystem services.

In contrast to the MEA, we seek to highlight access, rather than aggregate availability, to which drivers tend to be conceptually linked. Drivers are therefore not listed in Fig. 1. The diagram links drivers with external human influences, and to processes of degradation originating from the people sector of the framework, termed exacerbation (the converse of mitigation). In another shift of emphasis from the MEA, we diagrammatically present drivers acting on the ecosystem itself, rather than on services. While the MEA framework presentation may be simpler, it highlights changing levels of services, without providing for understanding links between services and underlying ecological change. In contrast, by representing biophysical structure, process and function, TEEB (2010) highlights the underlying ecology. Emulating TEEB allows analysis of ecosystem change that does not result in changes in services, but is nonetheless important. Norgaard (2010) points out that an ecosystem services lens is not the only way to approach nature and is not ubiquitously used by ecologists.

'External human influences' are presented to originate at a higher scale than from the 'people' sector, because these actors are geographically distinct, subject to different institutions, and they extract ecosystem services through means operating upstream of local dynamics of access and control. The implication is that these processes require separate investigation. External human influences link to three processes. First, they stimulate drivers; second, they consume ecosystem services; and third, they interact with the people sector of the framework through cultural exchange, a notable example of which is technology transfer.

We highlight consumption, relative to the generation of drivers, because it is highly significant, and has a distinct character. As noted, drivers cause ecological change, which may or may not be manifest in ecosystem services. In contrast, consumptive use of ecosystem services with rivalrous characteristics (in economic terms), involves the direct removal of services, influencing the ecosystem from the other direction than drivers, via effects on services. Consumption is the major global driver of land use change and environmental degradation (MEA, 2005; Srinivasan et al., 2008; Turner and Fisher, 2008; DeFries et al., 2010). Ecosystem services are consumed via appropriated land, or indirectly through the embedded services footprint of imported agricultural or manufactured commodities (see Weighell, 2011 for further analysis). The consumption of provisioning services stimulates ecological effects on supporting, regulating and cultural services, with wellbeing implications for the poor. While we do not seek to downplay the importance of local drivers of degradation, an innovation of the framework lies in the potential for a cross-scalar political economy analysis of the appropriation of ecosystem services. This opens up possibilities for examining trade-offs between the wellbeing benefits of those accessing ecosystem services through local channels versus globalized channels.

The Amazon region illustrates aspects of global demand for commodities, particularly soy and beef (Ewers et al., 2008). Ecosystem services are embedded in these intensively produced commodities, commonly as externalities (whereby costs in terms of degradation of ecosystem services are borne by agents outside of the market transaction). In the production of these commodities, ecosystems lose function, diversity and resilience, and are impaired in their ability to provide services. This is a familiar story: all land uses are manifestations of priorities for ecosystem services and there is a tendency to prioritise agricultural provisioning services above regulating, cultural and supporting services (Rodríguez et al., 2006; Elmqvist et al., 2011b). Whilst the story is familiar, research frontiers surround the trade-offs that arise from these sorts of priorities between services. Better understanding is required in relation to ecological feedbacks set up by exploitation of certain services, and resultant effects for ecosystem function, other services, and in turn, human wellbeing, potentially through generational timescales (e.g. Dearing et al., 2012).

Cultural exchange is the term we use to represent interactions between people and external human influences, potentially incorporating processes as divergent as global economic dynamics, or technology transfer. There is an important flow of technologies, both influencing peoples' interaction with ecosystems, and their wellbeing. For instance, efficient biomass stoves are commonly targeted for emissions mitigation, to protect forest carbon sequestration services (Schlag and Zuzarte, 2008). The framework presents cultural exchange extending both ways, but in a linear fashion. This is simply presentational: agency is important in the progression of cultural change, and it will tend to be unpredictable and strongly influenced by what already exists.

2.6. Human response options: adaptation and mitigation

Faced with environmental change, people have two fundamentally distinct responses to lessen the severity of the change: mitigation and adaptation. Whilst this terminology is now most commonly applied in relation to climate change, we use these terms in their more general sense. As represented in the framework diagram, mitigation is action by people to reduce the drivers of ecosystem change. Mitigation is demanding: it requires the detection of a problem and collective action to address drivers. Gautam et al. (2003) document the mitigating impact of a policy of Leasehold Forestry upon the degradation of the lower and middle hills of Nepal.[5] In Leasehold Forestry, groups protect land from grazing and fire, and use agroforestry, as well as allowing natural regeneration. This has resulted in up to a 70% increase in forest

[3] For reference, the MEA (2005) direct drivers are: changes in local land use cover; species introduction or removal; technology adaptation and use; external inputs; harvest and resource consumption; climate change; natural, physical and biological drivers.

[4] All the MEA (2005) indirect drivers are anthropogenic: Demographic; economic; sociopolitical; science and technology; cultural and religious. This is also consistent with the idea of the anthropocene (Crutzen and Stoermer 2000).

[5] It is worth noting that drivers are contested here, and may have been overemphasized and misattributed, forming a classic area of engagement for political ecology (Eckholm, 1976; Blaikie, 2007).

cover (Gautam et al., 2003), through mitigating deforestation drivers. Gautam et al. (2003) attribute this mitigation to the devolution of management to local people (cf. Ostrom, 1990, 2005).

In contrast to mitigation, adaptation is endogenous: a process of deliberate change in anticipation of, or in reaction to, external stimuli and stress (Nelson et al., 2007; 395). Adaptation is diagrammatically represented as such: a process undertaken by people, which changes their characteristics. Here, we are particularly concerned with understanding adaptation deriving from changes in availability of, or with implications for the use of, ecosystem services. Little literature is framed in these terms; over the timescale in which interest has risen in ecosystem services, there has been even more focus on climate change. Yet, water is a nexus of interest, linking ecosystem services and climate change. To illustrate adaptation, we focus on the high variability of water supply in arid East Africa. In this area, as with many situations the framework could be applied in, weather, climate, and environmental stressors are accompanied by multiple other sources of political, economic, and health stress.

Little et al. (2001, 403); identify various diversification strategies that pastoralists use in response to drought. These include mobility, trading (e.g. selling milk or firewood), wage labour, property rental, gathering wild produce for sale (e.g. gum arabica or medicinal plants) and sedentary agriculture. An application of the framework to this situation would facilitate understanding of how characteristics of people change through diversification, and the resulting implications for wellbeing. With reference to Section 2.3, it is important to note that people adapt by drawing on other means than ecosystem services (e.g. social networks, financial capital, education). Yet, it is striking how often services do feature in diversified strategies, for instance in trading, gathering wild produce, and in agriculture. This demonstrates the breadth and extent of the ecosystem services dependence of the global poor. Another element highlighted by Little et al., is how existing wellbeing governs the potential for adaptation, and in turn the potential for improved wellbeing through adaptation. Here, it is mainly the wealthy, through 'pull' factors of accumulation and investment, or the poorest pastoralists, through 'push' or necessity factors, that diversify; other groups apparently lack these pressures or motivations (Little et al., 2001). Therefore, we cannot assume that diversification is always a symptom of improving wellbeing; it may represent declining wellbeing, particularly for the poorest. Whilst the term adaptation has implicit connotations of beneficial change, there is also the potential for maladaptation (Adger et al., 2003; Coulthard, 2012). Highlighting, again, the power of the framework in analyzing social differentiation, adaptation and mitigation are processes manifest in differentiated ways.

3. Conclusion: Taking the ESPA framework forward

Integrated thinking is required on the environmental challenges faced by humanity. This ESPA framework consolidates multidisciplinary research themes, applying them analytically and innovatively to the nexus of ecosystem services, poverty alleviation and human wellbeing. Much emphasis is placed on social differentiation and its implications for access to ecosystem services: the social 'filter' regulating the contribution of ecosystem services to wellbeing. The framework also distinguishes between groups of ecosystem services on the basis of how easily they are controlled, and highlights a conceptual distinction between benefits from commodified, versus non-commodified services, giving entry points for holistic analysis of PES. In addition, indirect drivers are recast as explicitly anthropogenic, and the ecosystem services impacts of global consumption are highlighted. The framework reiterates important distinctions between human response options of mitigation and adaptation, and also between trajectories of poverty alleviation.

With the ESPA framework, we seek to stimulate and support applied multidisciplinary research towards policy goals of poverty alleviation and sustainable ecosystem management. We present the framework as an interdisciplinary thinking tool, the value of which is to support the description and understanding of a situation, for research and policy applications. Yet, because it is presented as a dynamic system, research applications that go beyond description may be possible, in which data, ideally qualitative and quantitative (Poteete et al., 2010), is judiciously used to populate parts of the framework, to support better understanding of dynamics and sensitivities in particular situations.

Field applicability has been central to the specification of this framework, and we briefly propose a number of indicative research and policy applications:

1. The framework could be used to appraise effects of a policy change in endowments, for instance, instituted through law. This would require a thorough understanding of existing structures of endowments and their mapping to entitlements, how these govern access, and in turn, affect wellbeing. Changes in these dimensions could then be assessed. This raises a more general point: endowments have clear policy leverage. A future version of the framework could highlight other areas of policy leverage (cf. Meadows, 1999), where interventions might be possible to increase wellbeing.
2. Another application might seek to understand how a shift in land use to prioritise agricultural provisioning services might lead to trade-offs against other services. Crucially, the ESPA framework could support understanding of how these trade-offs are differentially manifest in society. It may also be useful to take an SES resilience lens in such an analysis, to understand system dynamics and recovery.
3. A further application of the framework might be to support agent-based modeling (ABM), to understand dynamics and feedbacks between human decision-making and the environment. Modeling approaches have strengths in the analysis of system dynamics, and system behaviour under scenarios, potentially over large scales. Crucially, with regard to human behaviour, ABM diverts from assumptions associated with rational choice theory and neoclassical economics, informed instead by new institutional economics (e.g. Williamson, 2000), and potentially by empirical work (Janssen and Ostrom, 2006a, Robinson et al., 2007, Rounsevell et al., 2012). ABM can also incorporate adaptive learning (An et al., 2005), and deal with emergence: that outcomes can be more than the sum of their parts (Macy and Willer, 2002).

These therefore indicate the range of potential applications, and in presenting the framework, we invite testing and modification. It is through such experience that operationalisation guidance can develop, including for empirical research applications.

A final note of caution by way of conclusion. Frameworks sometimes attract criticism for bias towards particular emphases. The Sustainable Livelihoods framework has been criticized for not giving sufficient attention to political factors (Clark and Carney, 2008), perhaps because of disproportionate attention to capitals, apparently because they appear to be quantifiable (Scoones, 2009). However, these biases may have been assimilated in applications, rather than being intrinsic to the framework. This experience is pertinent for the ESPA framework, in which various components are quantifiable, directly or through proxies, whilst some aspects are fundamentally qualitative. Whilst we welcome innovative

applications, we caution against partial or misleading enumeration, which may lead to analyses that do not embody the holism we sought to capture. Applications of Sustainable Livelihoods gained momentum diverging from the original philosophy. When implemented in Nepal by a major development agency, it was sometimes in a technocratic and depoliticized manner, with a narrow focus on physical capital investment (Author Giri's observation), far from its early emphases (Chambers and Conway, 1992; Scoones, 1998; Scoones, 2009). To clarify, then, this ESPA framework has a normative positioning promoting social equity and environmental sustainability, accompanied by a commitment to operationalisation through mixed qualitative/quantitative methods. This framework is unlikely to provide any quick fixes, but it has research and policy applications as a tool for developing rich and contextual understanding of ecological, social and political dynamics, in areas where people depend on ecosystem services in a range of ways to support their wellbeing.

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