Conceptualizing assets and asset services in livelihoods and ecosystem analyses for poverty reduction

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Summary

Household assets are increasingly seen as critical in poverty dynamics, both for reducing vulnerability and escaping poverty. Asset based approaches have thus become central to poverty analysis and development policy. In this paper we contend that for a better understanding of the role of assets in poverty reduction processes we need to consider asset 'functions' in addition to asset stocks. Further, we propose that an analysis of asset 'attributes' (the factors that enable an asset to preform a particular function) provides a useful mechanism to examine social and other determinants of asset services.
Asset services (or functions) can be also conceptualized as ecosystem services and this presents an opportunity to integrate poverty analysis into ecosystem services frameworks. We present an Ecosystem Asset Function Framework and illustrate its potential to contribute to the analysis of the role of natural assets in poverty reduction with a case study of biodiversity change from southern India.

Key words: assets; poverty; ecosystem services; livelihoods

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1. INTRODUCTION

The application of the ecosystem services concept, or more specifically the links between ecosystem services and human wellbeing, has stimulated a new wave of research on poverty environment linkages. A central emphasis of many studies has been linking the environment to human welfare, typically by documenting the importance of the environment for household incomes and consumption and by reducing vulnerability in poor people's lives. However, although the role of the environment and natural resources in poor people's wellbeing has been well argued (e.g. Duraiappah, 2004), there has been less analysis of the processes by which the environment (or ecosystem services) contributes to processes of livelihood change or 'pathways out of poverty'.

Early contributions to the reinvigorated environment and development debate that followed the Millennium Ecosystem Assessment (MA) focused on the importance of environmental assets to the poor and drew on an asset-based approach to poverty reduction (Pearce, 2005; WRI, 2005). Subsequent research trends have been allied more firmly to the ecosystem-services concept. This has meant that although there has been a boom in research on the links between ecosystem services and wellbeing, less common are attempts to look at the relationship between ecosystem services and poverty reduction (development) processes. This occurs at a time when the role of assets in poverty dynamics has been prominent in chronic poverty research and policy.

In this paper we first draw upon the literature on the role of assets in poverty dynamics and argue for extending an asset-based approach to poverty reduction to consider more explicitly asset functions in livelihood change. We then propose integrating this asset-function approach within an ecosystem services framework to construct a conceptual framework that conceives natural assets as ecosystem services and presents a framework for analyzing their role in livelihoods and livelihood change. We finish by applying this framework to a case study of livelihood change in southern India.

2. ASSETS AND POVERTY ANALYSIS

Assets have gained increasing prominence in poverty analysis in recent decades. Three interrelated research and policy trends have contributed to this. First, work on poverty-dynamics has considered movements in and out of poverty and the reasons behind these; secondly, the widespread application of a sustainable livelihoods approach which places the asset portfolio of households at the core of livelihood strategies; and finally research on climate change adaptation in which asset holdings shape future resilience and vulnerability of households and communities. Vulnerability is an important theme that cuts across all three of these areas, and the role of assets in the management of risk is considered to be critical (see MacKay, 2008).

Research on poverty dynamics, using both panel data and qualitative life history analysis has contributed to a conceptualization of the poor as comprising households that are 'transitorily' poor (those who move in and out of poverty over time) and the 'chronic' poor (those who remain poor over a long period) (for a recent review see Radeny et al., 2012). Panel data showing evidence of significant movement of households across the poverty line (in and out of poverty) focused the attention of researchers on the reasons why households fall into and climb out of poverty (e.g. Sen, 2003; Krishna, 2004) and the policy mechanisms that may prevent the former and aid the latter (Carter and Barrett, 2006). Within these analyses the role of assets has come to the fore. The distinction between categories of 'chronic' poor and 'transitorily' poor can be debated (Barrientos et al., 2005) but for the purpose of this brief overview it will suffice to say that poverty reduction policy seeks to target the transient poor through social protection mechanisms that help people to retain assets when they experience adverse shocks, in other words to prevent households from

falling into poverty. The challenge of chronic poverty on the other hand is seen as the task of promoting the acquisition of assets by the very poor (Shaffer, 2008).

Research on poverty dynamics has also revealed the role of risk as a determining factor which plays a particular role in trapping households in poverty (Barrientos et al., 2005). This is a consequence of both the long-term impacts of shocks on household welfare and the effect of risk on household decision-making (Dercon, 2008). The widespread recognition of the role played household assets in managing risk has further strengthened the argument for asset-based approaches to poverty reduction (Siegal and Alwang, 1999; MacKay, 2008).

The widespread adoption of livelihoods approaches has also done much to focus attention on household assets in development research and policy. Within a livelihoods approach, households and individuals are conceived to construct their livelihoods strategies by drawing on a range of resources, characterized as 'capitals' and classified variously as natural, human, physical or produced, financial or economic, social, cultural and political, and locational or geographical (Scoones, 1998; Ashley and Carney, 1999; Bebbington, 1999; Siegel and Alwang 1999). These categories serve as a useful checklist for encouraging a holistic account of the resources households draw on in constructing their livelihoods and thus have become central to livelihoods analysis.

Important aspects of livelihoods thinking with respect to assets came from research into food security and vulnerability to famine (Scoones, 2009). Building on the work of Sen (1981), an asset-based approach to understanding vulnerability highlighted the importance of access to resources (entitlement). Research on the roles of different assets in coping with and recovering from food insecurity (e.g. Swift, 1989) underlined the importance of assets in reducing vulnerability of the poor.

A livelihoods approach recognizes that households' access to and use of resources is shaped by the prevailing social, institutional and political context. Although the Sustainable Livelihoods Approach (SLA) places emphasis on the institutional context of livelihood strategies, including wider political structures and relations, there has been a tendency for livelihoods analyses to take a micro-economic, household level focus and emphasize the 'asset-pentagon'.

More recently, research on adaptation in the context of climate change has advocated an asset-based analysis for understanding vulnerability and resilience (Heltberg et al., 2009). These approaches emphasize the importance of assets in reducing vulnerability and managing risk, which is considered to be a central element of adaptation strategies (Prowse and Scott, 2008).

2.1 Conceptualizing assets

Whether concerned with econometric analysis of poverty dynamics or changing asset holdings within a livelihoods approach, asset-based analyses often consider changes in asset holdings without reference to the functions of assets and the different roles they may play in poverty dynamics. In economic analyses of changes in poverty status, assets are commonly aggregated or assigned weights based on their marginal contribution to household income (e.g. Giesbert and Schindler, 2012). Asset holdings are treated as a quantitative indicator of structural poverty.

Studies which follow a SLA also conceive livelihood change as changes in the asset status of a household measured by change in each of five types of 'capitals': human, financial, physical, natural and social. Examples of this include assessment of change in a single indicator (e.g. area under cultivation, Knutsson and Ostwald, 2006); an index based on two or more indicators (Campbell et al., 2001) or a scale based on locally developed, qualitative assessment (Bond and Murkherjee, 2002) for each class of 'capital'.

Critiques of attempts to quantify changes in asset holdings are usually concerned with the problems that arise with the measurement of intangible assets (social and cultural capital). Yet measuring tangible assets is not without difficulty: Guyer (1997:113) raises the challenge of accounting for multiple values of tangible assets in economic models, noting that "many of the assets of the poor are intrinsically and necessarily polyvalent, particularly in the absence of formal-sector financial institutions; that is, people with few goods are likely to prefer to invest in, and maintain, goods that have multiple uses".

The importance of considering the multiple roles of assets, such as their savings and investment and social roles, has long been recognized in the case of livestock (Dorward et al., 2001). However, despite knowledge of the importance of functions other than income generation, the focus of livestock development interventions have generally been on increasing livestock keepers' incomes (Ashley and Nanyeennya, 2002). However, it has been argued that neglecting the significance of non-income functions can be to the detriment of poverty reduction (Alary et al., 2011; Siegmund-Schultze et al., 2011). The role of livestock assets in risk management for rural households in particular highlights the relevance of a broader conceptualization of assets for poverty reduction that takes into account their roles in reducing vulnerability and facilitating accumulation, in addition to their role as generators of income.

Therefore, behind questions about how much people 'have' of what kind of assets, are deeper questions about the ways in which asset portfolios actually reduce people's vulnerability to shocks and/or promote higher incomes (or other measures of welfare) and adaptability. First, knowing how much of various assets people 'have' does not tell us much about the ways that assets support people's livelihoods: "a simple assessment of an asset's worth does not capture fully the stream of lost financial returns, social utility and other benefits generated, […] nor highlight the negative effects of asset depletion" (Start and Johnson, 2004:19, drawing on Devereux, 1993). Second, and perhaps more fundamentally for those seeking poverty reduction, knowing how much people's assets have changed does not tell us much about the dynamics and pathways of livelihood change. This suggests a need for an improved qualitative understanding of the roles of assets in livelihoods and livelihood change.

An emphasis on the role of assets (such as livestock or other natural resources) in generating income in poor people's livelihoods does not take account of dynamic structural change that is inherent in processes of poverty reduction, growth and development. Swift's (1989) classification of assets as 'investments' (health and education, individual productive assets and collective assets); 'stores' (food, money); and 'claims' (obligatory requests or appeals that can be made on other households, officials, other communities, governments or the international community) is helpful in recognizing different roles for different kinds of assets. However this is done within the context of maintaining material consumption in the face of short-term shocks, and hence, in a sense, also focuses on income, albeit income smoothing and insurance. Recognition of the roles of livestock in reducing vulnerability and allowing savings and consumption smoothing has a similar, limited, dynamic dimension which illustrates ways in which assets can have roles in helping to mitigate transitory poverty.

However, potential roles of livestock, and other forms of saving, in accumulation go further than this, introducing a role for assets in poverty reduction and livelihood change – a pathway out of chronic poverty (see Kabeer, 2004, for a discussion of 'livelihood ladders' or Dorward et al., 2009, for distinctions and relations between 'hanging in', 'stepping up' and 'stepping out'). Assets held by households are critical to this process of accumulation through their roles or functions in production, saving, buffering and consumption smoothing. Dorward et al. (2005) suggest that the

portfolio of assets held by a household should be considered in terms of the mix of functions available rather than the types of capital held by a household. Similarly Davis (2011:11) concludes from life history analyses of poverty dynamics in Bangladesh that "different types of assets play quite different roles in processes of improvement or decline, production or protection". These functions are also central to adaptation in the context of climate change, a concern underpinning two recent studies which examine livelihood change in terms of the role of assets in resilience and adaptation to climate change: Osbahr et al. (2008) discuss the functions of different assets to develop an understanding of coping strategies; Sallu et al. (2010) discuss processes of investment and accumulation of assets in relation to livelihood trajectories.

In addition to the different roles played by individual assets, the combination of assets or the 'asset portfolio' of individuals and households needs to be considered. Households manage assets to meet household welfare goals and to minimize risk, hence the asset portfolios of the vulnerable poor are considered to be more defensive and less profitable (Barrientos et al., 2005). Reardon and Vosti (1995) consider the composition of a household's asset portfolio when examining the relationship between household asset holdings and investment strategies. They propose a framework for considering how the profile of asset holdings by the poor, in particular the type of assets that are lacking, influences investment decisions with specific reference to the environment.

To summarize, it appears that despite some exceptions, the dominant discourse on livelihood assets in poverty reduction has focused on assets' income generating functions and on their role in reducing vulnerability, and to a lesser degree on accumulation, insurance and consumption smoothing functions in processes of livelihood change. These functions are of course linked, as income allows asset accumulation and asset accumulation protects incomes, increases incomes, and promotes adaptive capacity in the face of long-term change. However, these non-income functions are clearly important, and we argue that a conceptualization of assets for poverty reduction should consider these explicitly. Nonetheless, even a broad conceptualization of assets and assets function still raises a number of questions about the treatment of assets in socio-ecological systems. In the remainder of this paper we focus on three:

- First, is a focus on asset functions centered on income generation, accumulation, insurance and consumption smoothing adequate? Can we broaden this range to include other functions of natural assets and provide a more complete account of the role of natural assets and ecosystems in people's livelihoods?
- Second, what is it that enables different assets to fulfill or perform different functions in different contexts?
- Finally, how are different scales of asset functions, operating both outside and within household livelihoods, related to household livelihoods and livelihood change?

3. ASSET FUNCTIONS IN SOCIO-ECOLOGICAL SYSTEMS

We address the question of the range of asset functions that need to be considered in the analysis of people's livelihoods by drawing on insights from extensive debates on the concept of ecosystem services. We focus on the conceptualization of natural assets in rural livelihoods but as we shall see make a wider and fundamental contribution to the concept of asset functions in livelihoods and livelihood change.

3.1 Natural assets

Valuable research has been carried out to document the multiple but often 'unseen' benefits ('hidden harvest' or 'invisible capital') that rural communities derive from their environment in a range of contexts (for example Gujit et al., 1995; Cousins, 1999; and more recently studies within the Poverty Environment Network, PEN, 2007). These studies have been important in

demonstrating the value that local communities derive from natural resources that had been neglected previously by conventional accounting methods. The growing traction of the ecosystem services concept has further encouraged a broader consideration and valuation of the benefits derived from natural resources to help capture the economic value of natural assets to local people. However, as with the example of livestock, this conceptualization of natural capital tends to focus on the consumption (including income) function of natural assets and pays limited attention to other functions which may have important implications for wider dimensions of livelihood development and poverty alleviation. Following from our discussion above we propose that a narrow view of the role of natural resources in livelihoods analyses needs to be broadened to consider other important livelihood functions such as savings, investments, and social and cultural roles.

A review of early experiences with the sustainable livelihoods framework noted that definitions of natural capital needed reorienting to consider the services derived rather than just natural resources themselves (Carney, 2003). This reflected growing acceptance of the concept of 'ecosystem services', which has since been widely embraced as providing a basis for assessing human benefits from natural capital. Drawing on earlier work by, for example Constanza and Daly (1992) and Perrings et al. (1992) the Millennium Ecosystem Assessment (MA) defined ecosystem services as the benefits people obtain from ecosystems (MA, 2005). The 'ecosystem services' concept thus encompasses benefits derived from ecological processes as well as the direct use of natural resources. It also recognizes the non-use or existence values of ecosystems within a category of 'cultural services'. The conceptualization of 'ecosystem services' has been an important step in making visible the functions of the natural environment in terms of ecological processes that are necessary for human well-being. Ecosystem services therefore present a useful starting point for considering the wider functions of natural assets.

However, although used widely, the term 'ecosystem services' is not consistently defined. In a widely cited classification, de Groot et al. 2002 eschew the term services and define ecosystem functions as "the capacity of natural processes and components to provide goods and services that satisfy human needs". The functions listed by de Groot are close to those listed as services by the MA and classified as supporting, regulating, provisioning and cultural.

One criticism of both these classifications is that both processes and outputs are identified as services (or functions in de Groot's terminology). Wallace characterized this as mixing ends and means. To resolve this problem Fisher et al. (2009) propose identifying Intermediate services, arising from interactions between ecosystem structure and processes, and Final services which are the consumed outcome. Within this framework services are strictly ecological phenomena and thus distinct from benefits. Benefits are defined as occurring at "the point where human welfare is directly affected and the point where other forms of capital (built, human, social) are likely needed to realize the gain in welfare" (2009: 646).

Wallace arises at a similar conclusion: he defines the point at which the service arises as the end point of linked ecological processes at which the asset is consumed, "the point at which an ecosystem directly provides an asset that is used by one or more humans" (2007:240). Similarly Boyd and Banzhaf (2007) propose the concept of Final Ecosystem Service and Goods (FEGS) as ecological components that are directly consumed, and recent publications suggest that this approach is becoming accepted as a useful way forward (Nahlik et al., 2012).

Jax (2011) therefore defines ecosystem services as "those components and processes which are used, required or demanded from ecological systems (and only if they are used, required or demanded: otherwise they may at best be potential ecosystem services)" and continues "Services

are thus a subset of ecosystems services and products, depending on specific societal contexts" (p70). With Wallace (2007) he takes an opposite view to de Groot et al. 2002 and avoids the term ecosystem function. He sees this as an ambiguous term, perhaps in part at least due to his choice of ecosystem functioning as a valuable (but still constructed) term in ecological research.

Table 1. Defining ecosystem services and functions in different frameworks

Table 1 draws this debate together. It summarizes and compares the various positions discussed above and suggests an alternative Ecosystem Asset Function framework. Like Wallace, Boyd and Banzhaf, and Jax, this defines ecosystem services as those services (or goods and services) which are actually and directly valued and consumed (allowing existence as a service that is consumed in the case of existence value). Ecosystem functions are then the primary, intermediate and final processes which support and deliver goods and services. As with Jax's ecosystem processes, this avoids difficulties in distinguishing between intermediate and final services. However we consider the teleological ambiguity and the social construction of the term functions as appropriate for the consideration of socially constructed ecosystem / livelihood relations. We therefore place ecosystem services as an integral part of ecosystem functions.

Table 2 An Ecosystem Asset Function Framework

Table 2 elaborates some of the thinking behind the Ecosystem Asset Function framework. The core of the framework, in the upper part of the table, is the way that natural capital in an ecosystem (termed assets) supports ecosystem processes, which provide functions that support human activities from which people derive benefits. Table 2, like Table 1, moves from primary processes on the left to consumption of services on the right. It is important to recognize the feedbacks that exist and operate across these. The lower part of the table illustrates the framework with a simple example of goat keeping. This introduces the importance of different kinds of assets (human, social, physical and financial to use the sustainable livelihoods classification) that are necessary complements in the management and use of natural assets.

This framework is helpful in a number of ways. First, it separates assets, functions and activities. This is important as both assets and activities can be examined in terms of functional contributions to livelihoods (a difficulty faced in the studies of Osbahr et al. (2008) and Sallu et al. (2010) of asset and activity functions in resilience and adaptation to climate change). Second, by putting together in the same framework ecosystem services, complementary assets and asset functions it encourages more holistic thinking about these different discourses, and in particular about asset functions. In this it recognizes the complex dependence of services on deeper functions (Wegner and Pascual, 2011) as well as the almost universal interactions and interdependence of these often artificially separated spheres (P. Howard unpublished manuscript). Third, as will be evident later in the paper, unlike other frameworks linking ecosystem services to human needs, it encourages us to see these links not as static end points but as links into a process of change. Finally, the framework leads into the two questions posed earlier about the features or attributes of assets that enable them to perform different functions in different contexts and about scales of operation and analysis of asset functions. We consider these below, but it is important first to briefly discuss what we mean by assets and asset functions, and to consider ways that they may be usefully categorized.

3.2 Asset functions

The term 'assets' (like the closely related term 'capital') has multiple but related meanings in different contexts – notably in financial, economic and general use. A common core meaning across these different uses, however, is the concept of a stock (an item, entity, quality, or established process) which with other complementary assets in particular circumstances provides a flow of valued goods and/or services. A critical feature of assets is that their conceptualisation and definition is context specific and socially constructed depending on the effects of context.

We define asset functions as the roles that assets play in producing specific goods and services that support particular systems which in turn provide valued flows of goods and/or services as discussed above. Asset functions are context specific and socially constructed in the same way as assets are. A starting point for identifying the functions of an asset is to ask "why is X valued?"; hence asset functions can be considered as 'value categories' (P. Howard pers. comm.).

A classification of asset functions needs to take account of different categories and attributes of consumption of goods and services, and different ways that assets may indirectly contribute to these. The widely used Millennium Ecosystem Assessment classification of services (supporting, regulating, provisioning and cultural) is a useful starting point for considering the functions of natural assets and we combine this with insights from Swift (1989), Dorward et al. (2005) and Davis (2011) to include functions such as providing 'savings' (through stores), insurance or 'protection' (through claims or diversification), and 'exchange' or convertibility into other assets. We suggest 'production' and 'transformation' as terms for assets that produce new resource flows and also identify 'consumable' assets; these fall within the MA category of provisioning for ecosystem services. This gives us a list of eight asset function categories defined in Table 3.

Table 3. Classification of assets and functions

Three points should be made regarding the classification of functions; firstly, the conceptualization and definition of asset functions is context specific, we need to consider who, when, and where when classifying asset functions. Secondly, a classification should fit the decision context (Fisher et al., 2009). Here we are concerned with poverty reduction and processes of livelihood change. Thirdly, asset functions are also determined by scales of analysis – plants may be considered producers of oxygen or regulators of the composition of the atmosphere, depending upon the purpose and focus of analysis and investigation.

Finally, we should note that in addition to functions that are valued, assets may support processes that reduce flows of valued goods and services – and some components of a system (whether ecological or economic) may not appear to yield any valued goods and services but instead cause harm. Lyytimäki and Sipilä (2009) and Dunn (2010) refer to these as 'dis-services'. The allied concept of 'liabilities' is also useful here (Davis, 2011). A liability may be defined as a stock which in particular circumstances provides a flow of goods and/or services which have negative values or are seen as costs or a drain on production of other valued goods and services. The distinction between assets and liabilities will in some situations be clear. There may, however, often be ambiguity in this. Classifications may differ between individuals or groups with different resources, aspirations and perceptions and in different systems.

This discussion of assets and their functions may be illustrated by considering the simple example of goats. These may be valued for the meat and milk they generate (productive function with material, spatial and temporal transformations) which may be sold for money (an exchange and savings asset) and/or contribute to household diets (consumption function). They may be sold in times of stress (protective function), may be used to accumulate (savings function), may be important as indicators of wealth or gifted to fortify relationships (social functions), and may play an important role in nutrient cycling, soil formation and vegetation control and management (supporting and regulating functions). In illustrating the potential multiple functions of assets, this example also illustrates dangers from incomplete classifications of assets by their functions (or value categories): this may lead to over-emphasis on the most visible functions while less visible but perhaps more fundamentally important functions may be overlooked.

3.3 Asset attributes

We have so far considered the function of asset stocks in socio-ecological systems. We now turn to the attributes of assets that enable them to fulfill or perform different functions in different contexts. We think this is particularly useful for understanding how environmental change (whether intended, for example as a consequence of policy, or unintended) impacts on livelihoods – by considering not only changes in the asset holding – but the ability of the asset to serve certain functions.

Table 4. Attributes determining fulfillment of functions

Table 4 provides a non-exhaustive list of attributes which may be important in determining assets' fulfillment of different functions. A number of these categorizations may overlap, depending on the precise nature of the asset and function being considered. Some of the categories below may apply to an asset as a whole (and all its functions) whereas others may be specific to and differ between different functions. Different functions and attributes may have more or less relevance to different social and ecological processes and analysis and will also be viewed differently by social and natural scientists. Table 4 reflects a more social science perspective, although many of the attributes listed can be applied to both social and ecological processes and analysis.

Consideration of asset attributes allows an important extension to the asset function framework, noting that assets have multiple attributes which are specific to their biophysical and socioeconomic contexts and to different functions. The impacts of ecosystem change on poor people's livelihoods can now be considered in terms of two types of impact – changes in stocks of natural assets, and changes in the attributes of stocks. These changes in natural assets and in perceptions are normally affected not only by changes in environmental factors but also by ongoing processes of economic, social and cultural change. Asset attributes are, as for asset functions, context specific social constructs that vary between people with different resource sets: the attributes of particular assets are conferred/endowed by the context, rather than the product of innate characteristics alone. This allows a consideration of the role of cultural and structural forces in shaping asset attributes and thus brings structural considerations into the analysis. For example the 'complementarity' of a particular resource will be particular to the user, thus may be lower for a group who cannot use the resource due to lack of access to other (for example financial, labor) assets required to realize goods and services. Likewise, 'convertibility' will be higher for groups or individuals that can access markets or have knowledge and power to negotiate to their advantage. This highlights the need to analyze attributes for sub-groups of users and not lump all users together: asset-based analysis must focus on the characteristics of both the user and the asset. This responds to the need to disaggregate impacts when considering the role of ecosystem services for poverty alleviation (Daw et al., 2011)

3.4 Scales of operation

We now turn to consider briefly the question of scale in the analysis of assets. We consider this by making a number of observations with regard to interactions of scale with and across asset stocks, functions and services; asset attributes; and asset analysis.

First, we note that assets may fulfill different functions at different scales of system and subsystem definition in their interaction with each other and with people's livelihoods. Thus to return to our example of goat keeping, the asset functions of goats set out in Table 2 are the services that they, with complementary assets, provide to their owners (income, saving, consumption, insurance and social benefits). Later text, however, identifies another function of goats as their regulation of vegetation. If goats are kept on private land owned or controlled by the goat keeper, then this function will benefit the goat keeper (or harm the goat keeper's interests if overstocking leads to a reduction in grazing productivity). If however the land is communally owned, or open access, then the benefits or disbenefits from goats will affect a wider set of people using that land for a variety

of purposes. Whether the land is privately controlled, or a common or open access resource, impacts on water flows and quality will affect a wider set of people, not just the keepers of goats or owners of land. These issues are of course the concern of the extensive literature on property rights, where multiple uses and scales of use are an important topic (for example Mwangi and Meinzen-Dick, 2009). It is, however, important to make the point that these property rights of an asset are important attributes, and that these attributes affect other asset attributes in different ways for different people and for different (potential) functions.

Second, asset functions are conditional on proportionate asset stocks – if there is an imbalance in stocks of complementary assets then there will be diminishing marginal benefits and potentially increasing marginal disbenefits with increasing scale of the more abundant asset.

Third, as noted earlier asset functions may be determined by scales of analysis and the context and purpose of analysis: finer scales of analysis may separate out processes that are considered in their entirety at coarser scales of analysis. Thus forests may be considered as regulators of water flows and of the composition of the atmosphere, but depending upon the purpose and focus (system) of analysis and investigation this may be broken down into separate processes and functions of the soil and of different kinds of plants within forests (for example processes of transpiration and photosynthesis releasing water and oxygen into the atmosphere).

3.5 Accumulation of assets

A specific set of issues arise with regard to livelihood change and asset accumulation. As discussed earlier, asset accumulation is widely considered to be critical in poverty reduction, both to increase incomes and reduce vulnerability (Moser, 2006). Two issues face us when we discuss accumulation of assets. The first follows from our discussion of scale and leads to the question 'which assets are accumulated by whom and at what scale?' Within most analyses of poverty dynamics (and characteristic of a livelihoods approach) asset holdings at the household level are examined (e.g. Kabeer, 2004; Carter and Barrett, 2006; Davis, 2011). However, the multiple levels in our asset framework suggest a broader conceptualization of asset accumulation beyond the household. In short, the incorporation of ecosystem services into our range of asset functions raises the question of accumulation of natural assets (to increase the flow of goods and services) at higher scales (community, region, nation, global). It also demands a consideration of accumulation in the Marxian sense. The growing literature on the appropriation of natural assets for 'environmental' ends, so-called 'green grabbing' (Fairhead et al., 2012) attests to the problems arising from the new exchanges made possible by Payment for Environmental Services. Thus the question of accumulation (and dispossession) of natural assets, particularly those with regulating and supporting functions, is an important one that is raised by our framework when we consider change in social-environmental systems at different scales, and demands closer consideration than we have space to give here.

The second issue, returns to the question of accumulation at household level and is concerned with the observation that values regarding accumulation differ between individuals, groups and societies. It is evident that different individuals and groups emphasize the accumulation of different assets. These differences may arise between men and women or between generations (see for example Ferguson (1992) for a discussion of differing patterns and possibilities of asset accumulation between men and women and between younger and older people in Lesotho).

Thus we may expect different aspirations for asset holding between members of a household or community. However, more profoundly we must also acknowledge differences in values between societies. To take an extreme but important example, an absence of accumulation of individually held material wealth is considered a feature of 'immediate-return' forager societies (Woodburn,

1982) and is fundamental to the egalitarianism observed in such groups in contrast to the wealth inequalities and social stratification of sedentary agriculturalists. The explanations for this 'different kind of sociality' (Lee, 1992) range from the ecological (patterns of resource availability) to the social (response to domination and marginalization by more powerful neighbors) and are fiercely contested (Gardner, 1991). Whatever the explanation, features of forager, or previously foraging, societies such as emphasis on individual autonomy and mechanisms to limit accumulation (property rights, social leveling) can persist and shape livelihood strategies and people's relationship to assets even when their livelihoods are no longer based on foraging (Dallos, 2011; Norström, 2003).

Recent attempts to model patterns of intergenerational wealth transmission in small scale societies supports ethnographic evidence that material wealth is less important than embodied and relational wealth in foraging and horticultural societies. Mulder et al. (2009) find material inequality and intergenerational transmission of wealth to be lower in foraging and horticultural societies where embodied and relational wealth (or human and social capital) are more important in people's livelihoods. Since social values and institutions tend to be embedded in each other, this suggests that in some societies people may not value material accumulation. This not only raises profound challenges for the conceptualization of poverty reduction as a process of material accumulation, it also affects people's perceptions of asset functions and attributes.

4. APPLICATION

We have outlined a framework for analyzing the role of natural assets in socio-ecological systems. We believe it can be usefully applied to analyze the impacts of ecosystem change on livelihoods, but we have also argued that to understand the linkages between ecosystem services and poverty reduction we need to conceptualize the role of environmental assets in livelihood change.

We therefore present a case study from an investigation into livelihood responses to invasion of the weed *Lantana camara* in southern India to illustrate the use of an asset function framework to explore the livelihood impacts of ecosystem change and the effects of this on patterns of livelihood change.

The village case study reported here was carried out as part of a study to investigate human adaptation to biodiversity change. The study village, Kombuddikki, is located within the Male Mahadeshwara Hills forest reserve in southern Karnataka which has suffered in recent decades from invasion by the notorious weed *Lantana camara*. Due to its effect on understory vegetation, the increased population of *L. camara* has potential impacts on all livelihood activities that utilize forest resources.

In Kombuddiki, two ethnic communities, the Lingayat and the Soliga, a scheduled tribe, draw on forest resources as part of diverse livelihood strategies which incorporate agriculture, livestock raising, labor migration to quarries, and extraction of forest products for income and subsistence. The ecological impacts of the *Lantana* invasion are experienced principally as a decline in availability of forest products (including grazing for cattle; wild foods for consumption; bamboo for basketry; and *Phoenix loureiri* for brooms) and obstruction of movement of humans and animals in the forest. Households and individuals respond to these changes within a wider economic context of declining land availability for agriculture, increased opportunities for wage migration, the introduction of Self Help Groups for savings and credit (SHG) and the expansion of social protection in the form of the Public Distribution System (distribution of food grains).

The functions and attributes of forest assets for different groups of users and perceptions of how these had changed over time were elicited from qualitative interviews conducted during nine weeks fieldwork in 2011. We considered the functions of different forest products within household

livelihood strategies in both ethnic groups. Table 5 provides a general, aggregate summary of assets and their functions in Kombuddiki livelihoods, it therefore needs to be interpreted in the light of differentiation on access to and use of assets, as we discuss below. This table serves to locate the contributions of the forest to the wider set of asset functions. The table also raises challenging but vital questions about the different and complementary functions of assets (not just forest assets), about what assets meet different functions, and about functions which are weak or missing. It also draws attention to functions which are provided by less tangible assets (such as regulatory functions provided by institutions or ecosystems) at wider scales.

Table 5. Principal assets and their functions for case study households

Since forest users currently have little power to control the spread and thereby limit the impact of *Lantana*, the capacity of households to adapt to changes in the forest can be usefully conceived as their ability to substitute the functions previously derived from the forest. However, access to assets differs widely between households and individuals and therefore capacity to substitute varies considerably. This is most apparent with regard to access to labor which impacts on households' ability to substitute forest-derived income with wages from outside work such as quarry labor.

Loss of forest grazing has significantly reduced the potential for livestock based livelihoods that were prevalent in the past. Households have adapted by periodic migration for labor work outside the village. For some households this has contributed to improved welfare, for example by facilitating investment in house building and in agriculture. However, this outcome is more often realized where joint households are able to cooperate in managing a diverse portfolio of activities. For example, in households containing parents and adult sons, younger men take turns to leave for labor work whilst the household members that remain maintain the farm and/or look after cattle. This type of household is more common in the Lingayat community and by comparison many Soliga households are in a more precarious position with regard to adapting to loss of forest assets.

The different pattern of resources use between the two communities suggests that an asset's functions are affected by relative complementarities and consequently are valued differently by the two communities. This highlights the importance of considering asset functions' complementarities and 'fit', as well as a range of functions other than income in order to understand livelihood strategies. A principal difference between communities with regard to forest products concerns the use of bamboo for basket making and the collection of *Phoenix* or broom (an understory palm). Both activities provide a source of cash income and are potentially open to all. However, the former is more prevalent among men in Soliga households and the latter more important for women in Lingayat households. Considering some of the reasons for these differences, whilst providing only a partial explanation, gives some insight into the potential impacts of decline in these resources on poverty and livelihood change.

In the case of bamboo for basket weaving, Soliga men value this because it is an activity that they can do in their own time and in relative comfort (compared to quarry labor), it can be resumed on returning to the village and requires no on-going investment. An important attribute is its complementarity with quarry labor, which is not the case for agriculture and livestock-raising outside the cooperative joint family. Basket makers also receive advance payment from traders and in this way basket making facilitates access to credit and is therefore important for consumption smoothing as well as income. The loss of this function would increase the vulnerability of households who would be more reliant on money-lenders since Soligas households do not currently have access to financial services provided by SHGs.

The collection of *Phoenix* takes place over a six-month period annually. A contract for its extraction is awarded by the Forest Department, and the holder pays workers to cut, tie and deliver leaves.

Lingayat women reported that they value this activity because it is one of the few income earning options available to women in the village. Furthermore, collection is compatible with domestic tasks (women often go out and return the same morning) and it is undertaken in the dry season when agricultural activity is lower. The value of *Phoenix* collection was also related to the role it plays in providing the regular savings required for SHG membership. The decline in availability due to *Lantana* may then have a differential impact on women who are less able to substitute this source of income. However, changes in availability of income under women's control also have wider implications for the potential dynamics of livelihood change, since income facilitates access to savings and credit through SHG participation. Loans taken out from the SHG are used for (protective) consumption smoothing but also to finance productive assets such as the purchase of livestock.

5. CONCLUSIONS

An analysis of asset functions and attributes in people's livelihoods provides a framework for analyzing the role of natural assets in livelihoods and identifying complementary assets that may be required to reach desired livelihood outcomes. The framework developed in this paper allows this within a conception of the benefits of natural assets as 'ecosystem services'.

We suggest that characterizing assets by their functions rather than type has advantages for considering the role of natural assets in poverty reduction. Operationalizing our eight asset functions within a specific case encourages an analysis of 'gaps' in essential functions. This can highlight important complementarities between assets and identify why certain groups (especially the poorest) may fail to realize the benefits of certain assets. Where poverty reduction is linked to a change in livelihood strategies (for example through processes of accumulation and investment in new productive activities) an analysis of missing functions can be useful in identifying missing complementary assets that enable households to transform their livelihood strategies.

However, it is important at this point to remind ourselves that individual or household assets alone do not determine livelihood outcomes. The recently completed ten-year research program of the Chronic Poverty Research Centre reported that poverty traps based on inadequate quantities of key assets were found in only a few cases, rather their research showed that "people are trapped by combinations of insecurity, poor work opportunities, locational disadvantage, limited citizenship and discrimination" (Shepherd, 2011:23). Asset-based approaches run the risk of being individualistic and thereby ignoring wider social processes which create poverty outcomes. By examining what people value in their assets and considering assets at different scales of holding, function and attribute we seek to acknowledge the social embeddedness of people's 'preferences', and that their agency is shaped by wider social and political structures (Cleaver, 2004; Rao and Walton, 2004; Mosse, 2007).

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Table 1. Defining ecosystem services and functions in different frameworks

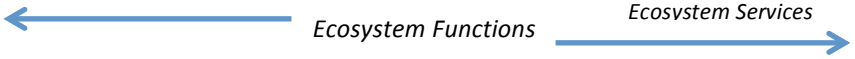
	Ecosystem			
Author(s) / Framework	Primary processes	Secondary processes		Consumption
MA (2005)	*Ecosystem services*			
De Groot et al (2002)	*Ecosystem Functions*			*Goods and services*
Wallace (2007)	*Ecosystem Processes*	*Elements: natural resources assets*	*Natural resources assets*	*Services*
Fisher et al. (2009)	*Intermediate services*	*Intermediate services*	*Final services*	*Benefits*
Jax (2011)				
Ecosystem Asset Function Framework				

Table 2 An Ecosystem Asset Function Framework

	Ecosystem			
	Primary processes	Secondary processes		Consumption
	Ecosystem Functions			*Ecosystem Services*
Human benefits				Human welfare
Human activities			Investment Harvesting	Consumption
Ecosystem functions		Ecosystem processes		
Natural & complimentary assets		Natural capital in ecosystems		
Goat example				
Human benefits				Meat/ milk income & consumption, saving, insurance, various social benefits
Human activities		Grazing land management / protection / cultivation	Goat keeping (buying, borrowing, breeding, herding, veterinary care, etc)	Slaughtering, milking, cooking, marketing, giving, lending, etc.
Ecosystem functions	Primary productivity Soil formation Water regulation	Forage Water provision	Goat (re)production	Income Saving Consumption Social Insurance
Natural and complementary assets	Solar energy, land, soil, hydrological systems	Forage plants, streams, groundwater, human knowledge and skills, household & community institutions	Goats, human knowledge and skills, goat housing, equipment, household & community institutions, finance	Household & community institutions, equipment, finance

Table 3. Classification of assets and functions

Asset function category	Description
Consumable assets	Assets that have a direct use value. For example direct consumption (foods) or assets used for fuel, or shelter
Social/ cultural assets	Assets / functions that may have social value for example as symbolic of status, or they may be used to establish social relations and fulfil social or religious obligations. They may have a social function relating to group identity. Some cultural assets / functions may overlap with consumable assets / functions, however a distinction may be made where assets have intrinsic existence value irrespective of use.
Productive assets	Those that generate new resource flows. These assets may represent an investment by the holder. Alternatively these may be considered as transformative assets, allowing distinctions between material, spatial, temporal and aesthetic transformations.
Exchange assets	Assets or processes that fulfil an exchange function, generating exchange value and serving as convertible income or savings. Exchange or convertible assets may also provide a buffering function, and thus be important for reducing vulnerability (providing insurance) or for consumption smoothing. Exchange functions and values may be limited by lack of complementary assets needed for exchange or for production for exchange, or by cultural determinants of acceptable exchange, for example where purchases of cattle are encouraged but not their sale (Ferguson, 1992)
Savings assets	Assets or processes that allow accumulation and/or storage value over time. May be associated with temporal transformations or convertible assets / functions (see above) or protective (insurance) assets / functions (see below)
Protective assets	Assets or processes provide protection or insurance against shock may either spread risks through diversification across assets or provide claims which can be drawn on following adverse shocks.
Regulating assets	Assets / functions that control patterns and limits with regard to, for example, climate, floods, temperature, chemical composition, sediment loads, disease, wastes, water quality, plant and animal species balances, etc
Supporting assets	Assets / functions that support other assets through processes such as soil formation, photosynthesis, and nutrient cycling (may be difficult to distinguish clearly from productive assets and functions)

Table 4. Attributes determining fulfillment of functions

Attribute	Description
Complementarity	Effects on other assets and their functions. Does use of this asset require other assets to achieve value? Does the use of this asset preclude the use of other assets/livelihood activities?
Convertibility	Exchange costs; access; lumpiness. How easy it is to convert this asset into cash or other investment or consumption resources?
Holding costs	Costs of maintenance, exclusion and maintaining access and control rights, depreciation.
Life	Expected period over which asset will be held, the rate at which benefits will fall relative to holding and use costs.
Use costs	The costs of accessing and utilizing a resource
Productivity	'Normal' productivity; sensitivity to and resilience under different conditions; appreciation of asset value
Reproduction/ replacement	Does this asset reproduce itself, with or without multiplication? Does this require intervention, if so what are the resource costs and timing?
Rules of access	Rights and responsibilities for access and for its acquisition or transfer, and costs and returns involved.
Security	Risks to asset (theft, loss of control or access, disease, death). Does this asset hold its value, how easy is it to steal, degrade, destroy? What are the costs and benefits different means of improving security or of protecting against loss.
Risk	Can this asset be accessed/used without risk of harm?
Social value	Does the holding/use of this asset confer/reduce social status or other social capital? What are the benefits of this?
Identity value	Does the holding/use of this asset contribute to identity, group belonging, heritage
Substitutability	Can the services provided by this asset be substituted by another?
Utility	'Normal' utility from direct and/or indirect holding or use of this asset; variability, sensitivity and resilience of this under different conditions. How well does this asset serve its expected purpose?

Table 5. Principal assets and their functions for case study households

Asset function categories	Household level	Community and local level
Consumption	Grain stores; PDS ration; houses	Forest products: foods (fruits, tubers, greens, game); fuelwood; timber; bamboo;
Social/ cultural functions	Livestock; houses; labor	Forest; temples/shrines;
Productive/transformative functions	Farmland; livestock; ploughs; labor; houses	Forest; labor; school;
Exchange functions	Farm products (maize, ragi); labor; livestock	Forest products (broomstick, forest fruits, bamboo, firewood).
Savings functions	Livestock; SHG savings; bank savings; jewelry	
Protective functions	Livestock; bank savings; jewelry; insurance;	SHG credit; forest products; money lenders; PDS
Regulating functions		Forest, other environmental assets
Supporting functions		Forest, other environmental assets; health services; water pump, roads, transport.