Dependence of the poor on biodiversity: which poor, what biodiversity?

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A State of Knowledge Review

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ABSTRACT

This State of Knowledge Review examines the evidence on the extent to which the poor depend upon biodiversity. It specifically focuses on the question: which groups of the (differentiated) poor depend, in which types of ways, on different elements of biological diversity? The review focused on two particular types of dependence: (a) biodiversity as offering a means of subsistence or income to the poor; and (b) biodiversity as offering insurance to the poor from risks and shocks, thereby preventing them from falling deeper into poverty.

The methodology for the review included an examination of the peer-reviewed literature, as published in journals and books, and an examination of websites and portals of major organisations/forums working on biodiversity conservation and poverty alleviation. Literature identified through these processes was systematically analysed to examine the empirical evidence on the extent and nature of dependence. Aggregation of the findings from this meta-analysis is difficult, given the methodological differences in the underlying case studies, but this paper reports on the trends that have emerged from this review.

There is considerable variation reported in the extent of household income that is contributed by biodiversity-based resources. Some of this dependence is very specific to particular groups, especially the poor. Some multi-sited studies demonstrate variability across different sites, reflecting both the availability of alternative income sources, as well as access issues and previous resource use patterns. Levels of participation in biodiversity based livelihood activities are also high, although there is some variation when this is broken down by wealth class, with the poor typically showing higher levels of dependence.

The literature suggests that biodiversity provides the poor a form of cost effective and readily accessible insurance against risk, particularly food security risks, risks from environmental hazards, and health risks. There is also some discussion in the reviewed material of the risks associated with declining ecosystem resilience. The evidence suggests that, as the poor have few alternative sources for protecting themselves, they have a higher dependency on biodiversity for dealing with risk.

The reviewed studies suggest that the poor tend to depend disproportionately on relatively low value or 'inferior' goods and services from biodiversity, while the more affluent groups may get interested in such resources if they have higher commercial values (often crowding out the poor in the process). Similarly, risk dependence of the poor on biodiversity takes the form of a last resort, in the absence of alternatives. This dependence of the poor on low value activities (and on biodiversity as a last resort against various forms of risk) may confirm the suggestion in some recent literature of a resource-based 'poverty trap'. This may have important policy implications, as it suggests that the poor may need to break their dependence on biodiversity in order to improve their livelihood outcomes.

1. INTRODUCTION

The poverty-environment relationship has been conceptualised in a variety of ways since first coming to attention during the 1970s. Understanding has evolved from relatively simplistic demographically-deterministic models which suggested an inevitable downward spiral, to a recognition of the institutional and structural contexts which result in these negative feedbacks, and an understanding of the wider political economy factors which shape resource use practices and environmental exploitation (Duraiappah 1998). Subsequently, studies have documented the importance of environmental resources for the livelihoods and incomes of poor people, suggesting that the impact of natural resource degradation was particularly felt by the poorest communities (Broad 1994, Scherr 2000, Nadkarni 2000). These studies demonstrated empirically that the poorest groups tended to derive a greater proportion of their household income and livelihood needs from the natural resource base, hence were disproportionately dependent on these resources.

More recently, attention has turned to attempts to understand the relationship between biological diversity and poverty, specifically in response to the growing convergence of these agendas within the international policy context (Adams et al 2004, Roe and Elliot 2005). Recognising these linkages, the United Nations Convention on Biological Diversity (CBD) adopted a decision in 2002 "to achieve by 2010 a significant reduction of the current rate of biodiversity loss at the global, regional and national level as a contribution to poverty alleviation and to the benefit of all life on earth." While the headline commitment to reducing biodiversity loss is unlikely to be met this year, the attention to the relation with global poverty alleviation targets has meant that these twin issues have been a growing focus of attention for global and national policy makers over the last decade.

Although these links between the biodiversity conservation and poverty alleviation agendas have been widely accepted, the specific nature of the

relationship between biodiversity and poverty is still not well understood. At their broadest level, two types of links can be identified: (i) biodiversity as a means of subsistence or income, providing inputs into poor peoples' livelihoods; and, (ii) biodiversity as insurance, providing a buffer against risks and shocks, helping smooth livelihoods and consumption patterns. While these relationships have been empirically documented in a wide variety of circumstances, there is still a considerable need to investigate these linkages more critically, and with greater analytical clarity. Crucially, recognising that both biodiversity and poverty can manifest themselves in different guises, it is important to interrogate a more nuanced question: which groups of the (differentiated) poor depend, in which types of ways, on different elements of biological diversity?

This document represents a first attempt to address this question. It is based on a systematic review of literature on the ways in which poor people depend on biodiversity as a direct contribution to their subsistence, income and other livelihood needs, and as a source of risk coping and insurance. It examines the published literature, in order to document broad trends emerging from existing knowledge about these relationships, and to identify key areas where there are knowledge gaps.

In the next section we address some fundamental conceptual issues which relate to the ways in which the terms 'biodiversity' and 'poverty' are used and understood. Section 3 describes the methodology used for the review. Sections 4 and 5 are the empirical core of the review, discussing in detail our findings about the extent to which aspects of biodiversity link with specific livelihood and insurance needs for people, especially the poor. Section 6 concludes.

2. DEFINITIONAL ISSUES

2.1 BIODIVERSITY

Biodiversity is widely understood to refer to three dimensions within which variability occurs: *genetic*, meaning the variation of genes within a species, sub-

species or population; *population/species*, meaning the variation between living species and their component populations at different spatial scales (local, regional or global); and *community/ecosystem*, meaning the variation within ecological complexes of which species are a part.

Defined in this way, relatively few of the detailed micro studies that were reviewed here explicitly focused on 'biodiversity', although the term is used more often in the risk and insurance literature. In the direct livelihood context, the term 'nature's resources' better captures the generic categories of resources that have been studied in this literature. These include forests, both in terms of wood-based and non-timber forest products (NTFPs) (forming a clear majority, together 18 out of 27 detailed cases); mangroves; fish; wild animals (bushmeat) and wild plants (including herbs); and common pool resources (CPRs) more generally (see also Figure 1). Many studies focus on tropical natural environments, so it is possible to make inferences about the importance of biodiversity, but we would suggest that these links need to be established more carefully.

Keeping this in mind, we need to be cautious about how we interpret the material that has been the subject of this review. While nature's resources are clearly very central to the livelihood strategies of the poor, we cannot make the assumption that these activities require or depend upon the existence of biodiversity. Indeed, lack of diversity may not harm certain types of uses (such as the harvesting of particular NTFPs), as long as the specific resource that is being exploited remains relatively abundant. Monoculture plantations of the most valuable species may provide sustainable inputs into household livelihoods, but may not be related to biological diversity in any recognisable sense.

Moreover, as several studies document, wild plants that are in increasing demand (for instance, for medicinal purposes) are frequently being domesticated for cultivation as their values increase, bringing their use patterns closer to those of farming systems (and thereby breaking the link with

'biodiverse nature'). The dependence of poor (and rich) rural populations on these species for their livelihoods does not necessarily change, but they are being managed in conditions that are very different to their origins in the wild. This raises important challenges to the ways in which we conceptualise these use patterns, although these distinctions (between 'wild' and 'farmed') may in some cases be less meaningful to the communities who are actually engaged in the management and exploitation of these species. In the agricultural context, studies show that in situ conservation of agro-biodiversity and the protection of wild species may have additional insurance value.

The different components of biodiversity (genetic, species and ecosystem) are not necessarily equally important in order to maintain the flows of resources on which the livelihoods of the poor depend. The literature on resource dependence does not trace the links between these components, the resources that emerge from nature, and the livelihoods of the poor. In terms of contributions to livelihoods, what is often valuable is the volume (in terms of extent and abundance) of a resource, rather than diversity. While an assumption can be made that wild resources, harvested from nature, do depend on the existence of biological diversity in a general sense, there is an urgent need to document more clearly the specific parameters of this relationship. Diversity at the ecosystem level is likely to be important for enhancing resilience, but the precise nature of this relationship needs to be explored in greater detail. Although these links are often asserted (as for instance, in the Millennium Ecosystem Assessment Conceptual Framework, where Biodiversity (Life on Earth) underpins all ecosystem services), the specific pathways through which changes in biodiversity affect poor people's livelihood choices and strategies need to be more carefully identified (Ash and Jenkins 2007).

2.2 POVERTY

It is widely recognised that our understanding of poverty has moved on considerably from its original definitions, which focused on (a lack of) income or wealth. Poverty is now seen as multi-dimensional, encompassing material

deprivation, the lack of access to other basic needs (education, health, nutrition and food security), the absence of political autonomy and empowerment, as well as the lack of freedom of choice and social inequality. Moreover, research also differentiates between the occurrence of poverty (its 'incidence'), its intensity, the extent of inequality (i.e. the distribution of income between rich and poor), its temporality (chronic versus temporary poverty), and its spatiality. Mainstream poverty research is becoming more sophisticated in its handling of some of these issues, both through a diversification of methods (quantitative and qualitative), as well as by more inclusive processes of assessment which increasingly include the perspectives of the poor (see reviews in Addison et al 2009).

In a wide ranging review, Angelsen and Wunder (2003) address the links between poverty and forests, and engage with the emergent, more sophisticated approaches to conceptualising poverty, and their potential implications for our understanding of the livelihoods of forest-dependent people. They suggest that it may be useful to distinguish between the way we 'think about' poverty, which can be multi-dimensional and complex, and the way we 'measure' it, which needs robust and reliable techniques that lend themselves to replication and comparison. To this extent, measurement may continue to rely on more narrow indicators, such as income, levels of consumption, or composite indices which assess wealth or stocks of assets, but discussion about livelihoods may focus on wider concepts which include both poverty (in this narrow sense), and 'human well-being', which can include many of the more difficult to measure concepts that have been highlighted in recent discussions about poverty.

In their review of the links between poverty, development and biodiversity conservation, Agrawal and Redford (2006, p.12) propose a useful way of "parsing poverty" in two ways: first, 'aspects' of poverty, in terms of incidence, intensity, inequality, temporality and spatiality; and second, 'dimensions' of poverty, such as income/wealth, education, health, nutrition, food security, political autonomy, empowerment, and social equality. These two concepts were used to interrogate the detailed case studies that form the focus of this review

(see Appendix, Table A1). Unfortunately, the reviewed material does not engage with poverty in its multiple aspects and dimensions, and tends to focus almost exclusively on the incidence of poverty defined in material wealth, or income terms (although the concept is usually expanded to include the values of non-market goods and services derived from nature). Some studies also pay attention to issues of inequality, though this is still measured in terms of income inequality (typically through the use of the Gini coefficent).

This parsimonious approach appears to be the general rule that has been adopted in the literature that is under review for the current context, which adopts a traditional and narrow approach to the measurement of (income) poverty. What is missing from most of these analyses are several of the more interesting dimensions that have been highlighted in recent poverty research, many of which have potential impacts on the ways in which rural people interact with nature's resources. For instance, while studies point to the seasonality of resource use, and the importance of natural resources both for meeting consumption and employment/income needs during lean seasons (for instance, de Merode et al 2004; Bene et al 2009), these analyses do not address the volatility of poverty, and the extent to which some rural populations cycle in and out of poverty, while others remain chronically poor. If nature's resources help to temporally smooth consumption and incomes, their poverty impacts may be better captured through an explicit focus on this temporality as part of our poverty measure, instead of restricting our understanding to annualised income or consumption (in which these temporary contributions from nature do not always feature as significant). Similarly, trying to incorporate wider issues of empowerment, social exclusion and autonomy may be very important in understanding the context within which particular groups experience material deprivation, and may help frame our understanding of the potential for resource based interventions to offer potential pathways out of poverty. So, for instance, increasing the value of nature based goods and services may result in their capture by politically powerful local actors, thereby excluding the very poor from access to potential benefits. Unless issues of political decision making and social inclusion are tackled at the same time, such resource based interventions may do

little to help the resource dependent rural populations who are their intended targets.

3. METHODOLOGY

This review is based on a careful analysis of the current state of knowledge, and differentiates between robust evidence, and claims that are less well-founded on empirical experience. Furthermore, it highlights uncertainties and differences of opinion in the available literature. The specific steps that were undertaken as part of this process were:

i. An examination of the peer-reviewed literature, as published in journals and books. A number of search terms were used to carry out a web-based search in major electronic databases of journal articles and books (including Web of Science, JSTOR, IngentaConnect, Science Direct, Digital Library of the Commons, CAB Abstracts, OCLC FirstSearch, as well as catalogues from the British Library and US Library of Congress). Access to these was secured using the resources of the Cambridge University Library, including both print and electronic holdings.

ii. An examination of websites and portals of major organisations/forums working on biodiversity conservation and poverty alleviation. Key websites that were examined were: Poverty and Conservation Learning Group; the Equator Initiative; UNEP-WCMC; International Institute for Environment and Development (IIED); Department for International Development (DFID); World Bank; Conservation International; The Nature Conservancy; Worldwide Fund for Nature (WWF); Center for International Forestry Research (CIFOR); and the Millennium Ecosystem Assessment (MEA).

The literature that was identified in these two steps was then further short-listed to focus on studies that provided direct evidence that was relevant to this review. A final set of 200 studies were examined in detail (as listed in the bibliography). From these studies, 27 specifically focused on empirical evidence

for the dependence of the poor on biodiversity for their income and subsistence needs (see Appendix Table A2 for details), while a further 22 dealt with evidence on risk coping and insurance.

4. DEPENDENCE ON BIODIVERSITY: DIRECT LIVELIHOOD LINKAGES

This review focused on the question: which groups of the (differentiated) poor depend, in which types of ways, on different elements of biological diversity? As has already been discussed, the extent to which the different case studies provided evidence on these issues varied greatly. Table A2 in the Appendix summarises the evidence from these case studies, which provides the basis for the discussion in this section. Given the variation in the extent to which each study has covered issues such as differences between different income classes in the population, impacts on economic and social inequality, and extent of dependence on identifiable elements of biological diversity, this section will summarise key trends that are emergent from this literature, but will not attempt any overall summary. Furthermore, all meta-analyses suffer from an important limitation, which is that the lack of consistency in case study methods precludes any easy aggregation of results, so this will not be attempted here.

Figure 1 provides details of the geographical regions that were represented in the 27 studies that were the subject of more detailed analysis, while Figure 2 breaks the studies down by resource type.

Figure 1: Case Studies by Geographical Region (numbers are percentages)

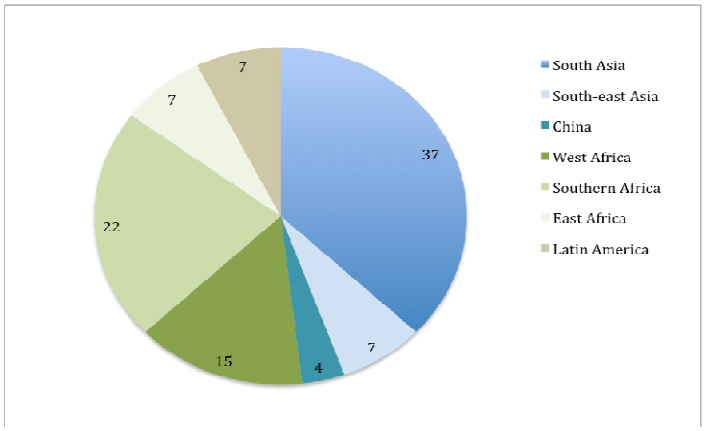
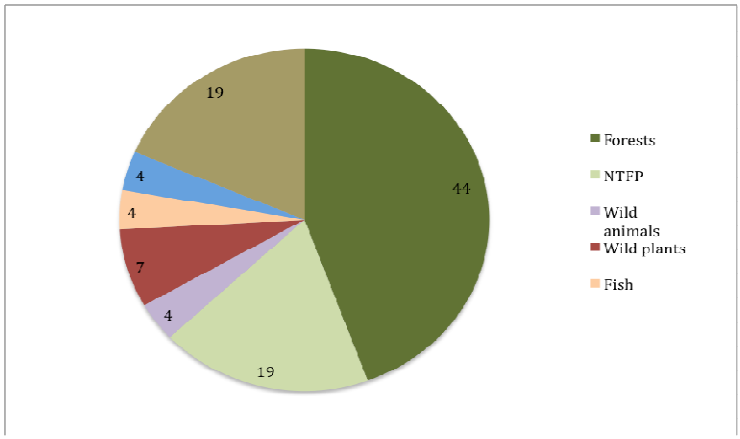


Figure 2: Case Studies by Resource Type (numbers are percentages)



This section provides an overview of the evidence on different types of dependence on biodiversity-based resources, primarily derived from micro studies at specific local sites. Unsubstantiated claims, such as those that are often found in larger macro- or sectoral studies, have not been included here, since the evidence for these claims is not available. What emerges from this review is a complex picture, with site- and resource-specific patterns of access, use and dependence, often reflecting very divergent patterns, although some regularities can also be observed from these studies.

4.1 Evidence on dependence

Most studies use income from biodiversity based resources as a percentage of total household income as their indicator of the extent of dependence. Table 1 summarises the findings from these studies.

Table 1: Evidence on dependence on biodiversity for income

Source	Region	Evidence	Resource type
Bahuguna 2000	South Asia	48.7% of household income	Forests: fuel, fodder, employment
Bene et al 2009	West Africa	Varies from 90% (poorest) – 29.7% (richest)	Fish
Cavendish 2000	Southern Africa	35.4% of household income in 1993-94; 36.9% in 1996-97	Wild foods, wood, grasses and other environmental resources
Coomes et al 2004	Latin America	20% of household income	Fish, palm products, timber, hunting
de Merode et al 2004	West Africa	24% of cash sales	Wild foods
Fisher 2004	Southern Africa	30% of household income	Forests
Fu et al 2009	Other Asia	1.7% of household income in Site 1, 12.2% in Site 2	NTFPs
Jodha 1990	South Asia	14-23% of total household income	Common pool resources
Kamanga et al 2009	Southern Africa	15% of total household income	Forests
Levang et al 2005	South-east Asia	30% of total household income	Forests
Mamo et al 2007	East Africa	39% of total household income	Forests
Narain et al 2008a	South Asia	Q1: 9%, Q2: 7.2%; Q3: 7.9%; Q4: 8% of permanent income	Fuelwood, dung for fuel, manure, fodder, construction wood
Shaanker et al 2004	South Asia	Site 1: 16%, Site 2: 24%, Site 3: 59% of household income	NTFPs
Viet Quang and Anh 2006	South-east Asia	For 30% of households, over 50% of total income; further 15%, 25-50% of total income	NTFP

As Table 1 demonstrates, there is considerable variation reported in the extent of household income that is contributed by biodiversity based resources. Some of this dependence is very specific to particular groups (such as the poorest fish-dependent groups in Bene et al 2009, for whom fishing represents 90% of household income). Moreover, some multi-sited studies demonstrate variability across different sites, reflecting both the availability of alternative income

sources (such as in the case of Fu et al's 2009 study of two sites in China), as well as access issues and previous resource use patterns (such as the variation across three proximate sites reported in Shaanker et al 2004).

A number of studies additionally report the proportion of households engaged in particular types of activities, which will be used here as an indicator of the 'depth' of dependence on biodiversity resources. These findings are summarised in Table 2.

Table 2: Evidence on depth of dependence on biodiversity resources

Source	Region	Evidence	Resource type
Coomes et al 2004	Latin America	66% of households depend on resource extraction	Fish, palm products, timber, hunting
Dovie et al 2007	Southern Africa	98% of households use NTFPs	NTFPs
Dovie et al 2007	Southern Africa	91% of households use wild herbs	Wild herbs
Glaser 2003	Latin America	68% of households depend on mangroves	Mangrove resources, especially crabs and fish
Jha 2009	South Asia	70% of households depend on *beedi* making or firewood	Forests
Jodha 1990	South Asia	84-100% of poor depend on CPRs	Common pool resources
Jodha 1990	South Asia	10-19% of rich depend on CPRs	Common pool resources
Levang et al 2005	South-east Asia	72% of households depend on forest products	Forests
Mamo et al 2007	East Africa	42% of households depend on forest for grazing	Forests
Narain et al 2008a	South Asia	Q1: 77.5%, Q2: 81.5%; Q3: 72.8%; Q4: 61.4% of households collect	Fuelwood, dung for fuel, manure, fodder, construction wood
Shackleton and Shackleton 2006	Southern Africa	96-100% of households purchase NTFPs	NTFPs
Shackleton and Shackleton 2006	Southern Africa	8% (rich), 15% (middle), 36% (poor) households sell NTFPs	NTFPs
Sharma et al 2009	South Asia	75% of household fuel and fodder needs from forests	Forests

Table 2 shows that the depth of dependence reported in these studies is high, although there is some variation when this is broken down by wealth class, with the poor typically showing higher levels of dependence.

A further set of studies also focus on biodiversity based resources as part of household consumption and production strategies (without monetising these values as a proportion of income). These studies are summarised in Table 3.

Table 3: Other evidence on dependence on biodiversity resources

Source	Region	Type of data	Evidence	Resource type
Bene et al 2009	West Africa	Consumption	Varies from 33% (poorest) – 20% (richest)	Fish
de Merode et al 2004	West Africa	Consumption	10% of household consumption	Wild foods
de Merode et al 2004	West Africa	Production	31% of household production	Wild foods

Overall, this data suggests reasonably high levels of dependence on biodiversity based resources, in terms of contributions to household incomes, as well as production and consumption strategies. Levels of participation in biodiversity based livelihood activities are also high, suggesting that the depth of dependence on these resources is significant.

4.2 Relative dependence on biodiversity resources: are the poor disproportionately dependent?

The evidence on the relative dependence of rich and poor groups on biodiversity based resources has been the subject of considerable interest, and is somewhat mixed. An early set of studies seemed to suggest unambiguously that the poor were disproportionately dependent on such resources (e.g. Jodha 1990, and Cavendish 2000). This became accepted wisdom, with overviews of the field consistently suggesting that the poor depend proportionately more on nature for their resource needs (Millennium Ecosystem Assessment 2005). However, more recent work has started to question this accepted view, and the studies reviewed here present a more mixed picture.

One factor that has been highlighted in recent work is the complementarity between asset ownership (especially land and cattle), and the use of certain types of biological resources (see for instance, Adhikari et al 2004, Coomes et al 2004, Coulibaly et al 2009, Fisher 2004 and Narain et al 2008a). In these

circumstances, asset rich households tend to depend more on nature's resources. If this difference in asset ownership is further reflected in greater political power at local level, rich households are also able to use their dominance to secure access to resources, and to exclude the relatively poor.

These differences in political power suggest another reason why resource use may be skewed in favour of the rich. While a biodiversity based resource remains relatively low value, rich users tend not to feel the need to restrict access. However, with returns to certain types of resources increasing as they become more valuable and in greater demand, the rich and powerful groups may try and capture these resources, and may exclude the poor from access (see for instance, Fisher 2004).

Table 4 summarises the evidence of the reviewed studies on the extent to which resource access increases or decreases with increases in household wealth.

Table 4: Evidence on relative dependence of rich/poor on biodiversity resources

Reference	Region	Resource	Relative dependence
Adhikari et al 2004	South Asia	Fodder	Increases with wealth
Adhikari et al 2004	South Asia	Leaf litter	Increases with wealth
Babulo et al 2008	East Africa	Forests	Decreases with wealth
Bene et al 2009	West Africa	Fish	Decreases with wealth
Cavendish 2000	Southern Africa	Multiple	Decreases with wealth
Coomes et al 2004	Latin America	Hunting	Increases with land ownership
Coomes et al 2004	Latin America	Palm fruit	U-shaped: first decreases then increases with wealth
Coulibaly et al 2009	West Africa	Forests	Increases with wealth
De Merode et al 2004	West Africa	Bushmeat	Consumption/sale increases with wealth
De Merode et al 2004	West Africa	Fish	Consumption/sale increases with wealth
De Merode et al 2004	West Africa	Wild plants	Consumption/sale decreases with wealth
Fisher 2004	Southern Africa	Low return forest activities	Decreases with wealth
Fisher 2004	Southern Africa	High return forest activities	Increases with wealth
Fu et al 2009	Other Asia	NTFP	Decreases with wealth
Jha 2009	South Asia	Firewood	Decreases with wealth
Jha 2009	South Asia	*Beedi* making	Increases with wealth
Jodha 1990	South Asia	CPRs	Decreases with wealth
Kamanga et al 2009	Southern Africa	Forests	Decreases with wealth
Levang et al 2005	South-east Asia	Forests	Decreases with wealth
Mamo et al 2007	East Africa	Forests	Decreases with wealth
Narain et al 2008a	South Asia	Fodder, construction wood	Increases with wealth
Narain et al 2008a	South Asia	Fuel, dung fuel, dung manure	Decreases with wealth
Paumgarten & Shackleton 2009	Southern Africa	NTFP	Sale decreases with wealth
Reddy and Chakravarty 1999	South Asia	Forests	Decreases with wealth
Sapkota & Oden 2008	South Asia	Forests	Decreases with wealth
Shaanker et al 2004	South Asia	NTFP	Decreases with wealth
Shackleton & Shackleton 2006	Southern Africa	NTFP	Sale decreases with wealth
Shackleton & Shackleton 2006	Southern Africa	Fuelwood	Consumption decreases with wealth
Shackleton & Shackleton 2006	Southern Africa	Edible herbs	Consumption decreases with wealth
Sharma et al 2009	South Asia	Forests	Decreases with wealth
Viet Quang & Anh 2006	South-east Asia	NTFP	Decreases with wealth

A number of interesting patterns emerge from the data that is presented in Table 4. 'Inferior', or low value, goods and services tend to be the ones that reflect the

conventional wisdom, in that the poor tend to depend disproportionately more on these resources. On the other hand, where commercial production and sales are involved, or if resources complement existing assets such as land and livestock, this relationship may be reversed. This has important implications for the potential of biodiversity based resources to be used as part of poverty-alleviation strategies, which is the subject of a parallel study. If the rich capture resources once they become more valuable, increasing the value of biodiversity based resources may not be a feasible strategy, since the poor may eventually lose out in such a scenario (Angelsen and Wunder 2003).

A second implication of this material is that there appears to be some confirmation of what Angelsen and Wunder (2003) have referred to as a 'poverty trap'. The poor appear to be linked with low value nature based resource use, but these low values may serve to perpetuate poverty. Here, poverty is endogenous, in the sense that biodiversity resource dependence is a symptom of poverty, and it is only by 'leaving the forest' that the poor can hope to escape poverty (Levang et al 2005). This, of course, is an important issue for discussion, since it has been widely believed that biodiversity based resources provide an essential safety net for the poor, preventing them from destitution. But, if this dependence is reproducing or reinforcing existing patterns of poverty, it may be important to examine alternative livelihood strategies in order to benefit these economically marginalised groups.

4.3 Impacts on inequality: does the inclusion of biodiversity based resources improve distributional outcomes?

If the poor do depend disproportionately on biodiversity based resources for their livelihoods, one outcome that emerges is that the inclusion of such resources in estimates of household income are likely to improve equity (measured in terms of reducing income inequality, or a lower Gini coefficient). A number of studies explicitly focus on this issue, and their findings are reviewed in Table 5, below.

Table 5: Equity implications of biodiversity resource dependence

Reference	Region	Resource	Impact on inequality
Fisher 2004	Southern Africa	Forests	Reduces by 12%
Jodha 1990	South Asia	CPRs	Lowers Gini coefficient
Kamanga et al 2009	Southern Africa	Forests	Lowers Gini coefficient
Mamo et al 2007	East Africa	Forests	Lowers Gini coefficient
Reddy and Chakravarty 1999	South Asia	Forests	Reduces inequality
Shaanker et al 2004	South Asia	NTFPs	Lowers Gini coefficient

While the data in Table 5 clearly demonstrates that these studies find improvements in distributional outcomes due to the inclusion of biodiversity dependent livelihood strategies in their analyses, there is reason to be cautious in light of the previous discussion about the dependence of wealthier groups on certain high value resources. Clearly, in these circumstances, distributional outcomes would be worse if we were to include biodiversity resources in our analysis, and a biodiversity based strategy would not necessarily improve equity.

Apart from their focus on measures of income inequality, a couple of studies also looked at other indicators of social inequality. Thus, Adhikari et al (2004) report a lower level of resource dependence amongst both female-headed households, as well as lower social castes. This is explained both due to restrictions on access, as well as the lack of ownership of complementary assets such as land and livestock. The influence of caste is also remarked upon by Sapkota and Oden (2008), although they show a greater degree of dependence among lower castes. In their study, Bene et al (2009) report than while only 69% of women sell fish, 98.6% of men do so, thereby suggesting that women are less likely to engage in commercial or market driven development opportunities in this context. Glaser (2003) remarks that 'pure subistence products' are most important for the weakest sections, especially women and children. Levang et al (2005) reflect on the importance of geographical isolation, and suggest that resource dependence is highest in remote areas due to the lack of alternatives (suggesting an interesting spatiality to the issue of biodiversity resource dependence). This is also reflected in Fu et al's (2009) study which shows greater dependence in the less developed (remote) village as compared to the more developed (better connected) village.

5. DEPENDENCE ON BIODIVERSITY: INSURANCE AND RISK COPING

This section focuses on reviewing the empirical evidence on the importance (in terms of various measures of impact on human welfare) that specific 'components' and/or 'attributes' of biodiversity have on the ability that the poor have to deal with risks and shocks. In other words we assess the 'insurance value' of biodiversity to the poor based on how biodiversity is defined or conceptualised in each study. The empirical literature on biodiversity as a means for risk coping is *considerably smaller* than that on biodiversity as a source of livelihood. The bulk of this risk coping literature is related to food security. There are considerably fewer studies on natural hazards and no specific studies on the insurance value of biodiversity with respect to the risk of reduction in ecosystem resilience, or the risk of ill health. Moreover, the methods used to assess 'dependency' are more varied than those on biodiversity as a source of livelihood. This makes tabulation of results (as in the previous section) less informative.

The literature discusses three main categories of risks in relation to biodiversity: food security risks (e.g. high variability in crop production); environmental and weather hazards (e.g. storms; floods, mudslides etc), and health risks (e.g. risk from infectious diseases; risk of illness due to lack of wild medicinal herbs etc). A fourth type of risk that is discussed in the biodiversity and poverty literature is that of risks that are associated with degrading ecosystem resilience. This refers to a stability property of ecosystems that reflects the capacity of a system to absorb shocks (Perrings 1995), or the rate at which a system variable returns to the reference state after perturbation (Schläpfer et al 2002) This is a more complex risk to isolate as it permeates the three other type of risks mentioned above. Low levels of biodiversity are argued to lead to lower levels of resilience which 'lowers the bar' of the tipping point for a particular ecosystem; i.e. the threshold point below which the ecosystem is not able of providing the same type, level and quality of ecosystem services as before.

5.1 Agro-biodiversity for food security insurance

There is considerable evidence from the ecology and agronomy literatures on the relationship between agro-biodiversity and crop productivity and variability and yield shocks. There are various complex channels that give rise to these effects. For example, diverse crop species are shown to adapt better to environmental changes since the larger pool of different metabolic traits and metabolic pathways enables them to more effectively use resources (such as water and soil nutrients) over a broad range of environmental conditions. (Schlapfer et al 2002). Also, biodiversity has been shown to improve ecosystem resilience which provides insurance against crop failure due to shocks (Perrings 1995, Tilman and Downing 1994; Tilman 1996).

At an economic policy level the benefits of agro biodiversity for the poor have been acknowledged within the environment and development literature (e.g. review papers by Heal 2000; Jackson et al 2007; Pascual and Perrings 2007; Perrings 2001; Perrings et al 2006; Perrings 2007; Ravi et al 2006 Smale and Drucker 2008). Further the theoretical economics literature has developed bio-economic models that have clarified and defined in economic terms the insurance benefits or value that agro-biodiversity entails (e.g. Evenson et al 1998, Weitzman 1993; Polasky and Solow 1995; Baumgartner and. Quaas 2008, Chavas 2009; Heal et al 2004; Schläpfer et al 2002; Quaas and Baumgärtner 2006). These biodiversity benefits are then conjectured to be more important for the poor as they provide a cost effective insurance policy against the risk of food insecurity to segments of the populations that do not have alternative risk coping mechanisms (Heal 2000).

Our review suggests that the empirical evidence documenting the degree and nature of this dependence (i.e. how valuable is this insurance value to the poor) is a dynamic body of work with several notable advancements but with significant shortcomings. The most informative body of work concerns studies that have explored the impact of on farm crop genetic diversity on output (mean of yields) and variability (variance of yields). This has been accomplished using

both regional and plot level data. Variants of stochastic production function approaches and forms of hedonic analysis have been used. The main dependent variables of these studies are mean and variance of the yield of a specific crop (or family of crops). Only a few studies have focused on assessing variability of income (e.g. Di Falco and Perrings, 2003). The main independent variables are those prescribed by economic theory to be included in the estimation of production functions (e.g. input data as well as other socio-economic variables) plus some measure of agro-biodiversity. Various measures of diversity have been used depending on the nature of the study. The main examples of these studies are: Just and Candler 1985, Smale et al., 1998, 2003, 2008; Widawsky and Rozelle, 1998, Meng et al 2003; Di Falco and Perrings 2005; Di Falco and Chavas 2008b; Heisey et al 1997).

A very strong and consistent finding across all these studies is that the coefficient of on farm crop genetic diversity has a strong positive effect on the mean of crop yields and a negative effect on the variance of crop yields. This implies that on farm agro-biodiversity reduces food risk insecurity, something which is particularly important for the poor. It is important to note that this result is robust against different production function specifications, different types of crops, different scales of data (regional vs. plot specific) and different measures of crop genetic diversity. The policy implication of this body of work is that though environmental changes such as rainfall reductions have adverse effects on agroecosystem productivity, these adverse effects can be buffered in the short term and possibly reversed in the longer term under increased agro-biodiversity. In other words, this body of evidence suggests that agro-biodiversity can buffer and insure the poor against negative environmental effects and support the resilience of the system under adverse weather conditions associated with climate change (Di Falco and Perrings 2008).

A few recent production function studies have expanded upon the work noted above and have also tried to examine the value of biodiversity not only as insurance against yield variability but also against the risks of total crop failure due to exogenous shocks (e.g. storms, new invasive pests etc). The main

examples of this are in work by Di Falco and Chavas (2009, 2008a and 2006). Their approach is also based on estimating a stochastic production function but their work does not only assess the impact of genetic diversity on the mean and variance of the production variable but also explores the impact on higher moments of the distribution, namely skewness. An increase in the skewness of yield entails a reduction in downside risk exposure (i.e. a decrease in the probability of crop failure due to shocks). For example in their recent work Di Falco and Chavas (2009) use plot level barley production data from Ethiopia and show that agro-biodiversity (more diverse portfolio of barley landraces) increases farm productivity of barley in Ethiopia farms. Further they show that agro-biodiversity decreases downside risk exposure (by increasing skewness of the crop yield distribution). This effect is shown to dominate other confounding effects so that higher biodiversity tends to reduce the cost of risk (as measured by their estimated risk premiums). Finally, they also find that the risk benefit of biodiversity becomes larger under less fertile soils which offers empirical evidence that biodiversity can aid farmers to cope with harsh climatic conditions, especially in degraded lands. This last finding has implications for poorer segments of the population that tend to use and occupy less fertile, degraded, and marginal lands.

Beyond the relatively homogenous type of work mentioned above (relying on production function approaches) there are a few other empirical studies that shed light on the dependency of the poor on agro-biodiversity for food security insurance. Some studies try to compare more directly the impact of adopting modern crop varieties (often provided by aid agencies) as opposed to using traditional landraces on agricultural production decisions and outcomes. Though modern varieties are developed to be more efficient they do require specific types and quantities of inputs and hence may not be helpful in remote poverty-stricken areas where labour and other inputs are scarce. The rationale in this empirical work is that widespread adoption of modern varieties erodes genetic diversity and this may have implications for coping with food security risk in marginal low productivity lands. For example, Lipper et al (2008) study subsistence level sorghum production in Ethiopia. They show that the likelihood

of crop failure due to drought increases as the likelihood of adopting modern crop varieties (over traditional landraces) increases. This effect is found to be worse for marginal low production farms occupied by the poorer segments of the population. This provides further support regarding the insurance value of traditional landraces (which have a higher degree of genetic diversity as compared to modern varieties).

Other evidence comes from the literature that assesses the factors that impact decisions to conserve in situ crop and animal diversity (see Van Dusen and Taylor 2005). For example, Van Dusen et al 2007 study decisions to conserve diverse rice landraces in Nepal. They find the decision to conserve a diverse portfolio of rice landraces declines with income and increases with distance to markets. Both effects suggest a dependence of the relatively poor on agro-biodiversity. Similar findings are reported in Mexico (in Van Dusen et al 2000). Lastly, there are a few stated preference studies relying on choice experiment methods. These methods directly elicit farm household preferences for different levels of agro-biodiversity with the aim of calculating the welfare (consumer surplus) associated with conserving on farm genetic diversity (e.g. Birol et al 2009 and 2006). This work shows that landrace conservation has a significant welfare enhancing effect (measured as a change in consumer surplus) on farm households in developing countries.

With respect to the role of livestock as insurance for the poor, there is discussion and evidence in the development economics and development studies literature which suggests that this is significant (e.g. Dercon 1998, Fafchamps et al 1998, Kinsey 1998). Further there is some recent literature discussing the special role of animal genetic resources (as a distinct concept from livestock), characterised by the properties of flexibility, resilience and diversity. It is suggested that such animal genetic resources provide an enhanced form of insurance, as they are vital assets for the livelihoods of the poor (Anderson, 2003, Wollny 2003). However, there are no empirical studies which detail the insurance value of access to diverse animal genetic resources. Likewise, there has been little empirical exploration of the benefits to the poor of landscape level biodiversity

as an insurance mechanism against high levels of crop variability (for example via its function as enhancing resilience), although this link is scientifically plausible and explainable both in ecological and economic terms.

5.2 Wild food products, biodiversity and food security

The literature on the dependence of the poor on biodiversity-related income is also useful in providing insights on the role of wild food products, in particular for coping with the risk of food insecurity. For example the Vedeld et al (2007) meta-analysis suggests that together with fuel wood, wild food products are the main source of forest related income and consumption. This sort of evidence lends support to the idea of forests as 'safety nets'. Yet (and what concerns this review), the value of the 'diversity' of wild food items or the value of diverse ecosystems as providing better qualities and quantities of such wild foods is not well documented.

A few studies assess the role of tropical forests (and hence biodiversity rich ecosystems) as an insurance against food security (and income) variability. Pattanayak and Sills' (2001) study on the Peruvian rainforest and Takasaki et al's (2002) work on the Brazilian Amazon are both based on household level data and suggest that poor households in these tropical areas use the forest to cope with ex ante risks and ex post shocks. Pattanayak and Sills (2001) found that time spent collecting forest-products was correlated with agricultural yield risks (an income smoothing response) and unforeseen production shocks (a consumption smoothing response). One of the main findings of the Takasaki et al. (2002) study was that the insurance value of the forest (as a source of wild non-timber forest resources during unforeseen shocks) was much more significant for the poorest segments of their sample. The micro-econometric study by Fisher and Shively (2003) on communities living at the margins of tropical forest of Malawi corroborates and complements these earlier findings. They find that rural households rely on tropical forests (for wild foods) for coping with income and consumption shocks and that asset poor households are even more dependent on forests for dealing with such shocks. Similar findings

are reported in Akinnifesi et al 2006; World Bank 2007, McSweeney 2003; and Sunderlin et al 2000. Hence, at least for the case of poor communities living close to tropical forests, there appears to be support for the conjecture that forests act as a safety net against food insecurity.

5.3 Biodiversity and natural hazards

Rural poor communities face serious risk from natural hazards the most common being floods, fires, hurricanes and storms, landslides and dust storms. The lack of market or government insurance of the poor against such hazards has been shown to lead to an exacerbation of poverty (Dercon 2006, 2005, 2004, 1996, Dercon and Krishnan 2000, Zimmerman and Carter 2003). Natural ecosystems can play an important role in mitigating these risks as they provide cost-effective insurance. This is achieved through complex inter-relationships between local geo-morphological traits, weather conditions, as well as soil and land-cover characteristics. Of these, vegetation and soil conditions are more susceptible to human interference (at least at the local level and in the short run). Ash and Jenkins (2007) summarise the links between genetic diversity (be it at the soil, vegetation or landscape level) and the mitigation of flood and fire risks. There is less evidence on the possible links between biodiversity and mitigating against other hazards, such as landslides, hurricanes and dust storms.

The risk of flooding is directly related to the water retentive capacity of the soils. This is related to soil and forest land traits. Diversity in soils and forests (e.g. type of plant coverage) is important for regulating water flows, though the exact mechanisms are not entirely clear. Still, the literature does seem to conclude that natural forests (which to some degree implies higher levels of biodiversity compared to plantation forests and agricultural landscapes) are associated with higher degrees of flood protection. Higher levels of biodiversity are associated with improved ecosystem capacity to regulate fire patterns, their frequency and their severity. For example, diverse plant species allow vegetation to adapt to fires and reduce wider disturbance of ecosystem integrity. Eroding plant biodiversity and introducing invasive tree species alter fire patterns by reducing

their frequency but severely increasing their intensity and extent. Natural resources such as mangroves have been shown to help local communities deal with the risk of hurricanes and storms (Das and Vincent, 2009). Yet, case study evidence linking diversity per se and protection against such harsh climatic events is scant. Both landslides and dust storms are impacted by the extent and nature of vegetation coverage across the relevant ecosystem landscape. With respect to the nature or type of vegetation, there is scientific evidence that shows that endemic vegetation outperforms invasive or introduced tree or bush varieties. Yet, links with biodiversity per se seem to be weak or at least not well understood (Ash and Jenkins 2007).

5.4 Biodiversity and health risks

There is a sizable body of research on the links between environmental conditions and health from the medical, epidemiological and social science literatures (see World Bank 2007 for a review). A small subset of this literature tries to investigate the links between biodiversity and health vulnerability (see Daily and Ehrlich 1996, and Chivian and Bernstein, 2008, 2004). Recent literature has identified two main avenues through which biodiversity provides a means for mediating health risk for the poor. The first has to do with the impact that biodiversity has on reducing the risk of infectious diseases. The second has to do with biodiversity as a source of accessible medicinal regimens which are not only curative but are also preventive, thereby reducing health risks (Burlingame, 2000; Chivian and Bernstein, 2008, 2004; Frison et a 2005; Grifo and Rosentha 2007; Huynen et al 2004, Johns 2006; Johns and Eyzaguirre 2006).

a) Biodiversity and risk of infectious disease

There is a growing literature documenting how biodiversity reduces risk of exposure to several types of infectious diseases. Biodiversity at the ecosystem level produces the appropriate balance between predators and prey, hosts, vectors and parasites which allows for appropriate controls and checks for both the spread of 'endemic' infectious disease as well as the resistance towards

invasive pathogens (from humans, animals or insects). Ash and Jenkins (2007) identify a large list of diseases as being particularly dependent on changes in ecosystem biodiversity. Most of these diseases are of particular relevance to the poor and include malaria (in all ecosystem types), schistosomiasis, lymphatic filariasis, and Japanese encephalitis (particularly in cultivated and inland water systems in the tropics), dengue fever (particularly in tropical urban centers), leishmaniasis and Chagas disease (in forest and dryland systems), meningitis (in the Sahel), cholera (in coastal, freshwater, and urban systems), and rabies transmission (in tropics forest lands)

It is evident that regions in the world with the highest levels of poverty are most vulnerable to such diseases. Biodiversity plays a role not only in reducing the risk of such diseases spreading within an ecosystem and the human population living within it but in many cases also reduces the risk of allowing invasive diseases from entering a particular system. For example, there is evidence to show that cholera, kala-azar, and schistosomiasis have not become established in the (biodiversity rich) Amazonian forest ecosystem despite the risk of this happening from human migration and settlements (Ash and Jenkins 2007).

b) Biodiversity and preventive wild medicines

Biodiversity has been recognised as an important source of traditional medicines (such as herbal medicines) for people in developing countries, especially where they have little (if any at all) access to formal health care. This lack of access to medicines and health services is even more acute in the remote and normally more poverty stricken areas of the developing world. It is estimated that approximately 75% of the world's population depends primarily on traditional medicines gathered from the wild. For example, the 'sweet wormwood' plant' produces traditional medicines that are increasingly important in combating drug resistant strains of malaria, particularly in Africa (DFID 2001). Though traditional medicines may not be as effective as compared to scientifically tested drugs, they do provide a cost effective and accessible option in poverty stricken communities. Ash and Jenkins (2007) make reference to the importance of

biodiversity as a medicinal source by providing some evidence of the number of wild plant species used as a source for curative and preventive drugs. For example, this number is well over 50,000 wild Chinese species (around 20% of all Chinese flora), over 7,000 wild species in India, and 10% of Indonesia's flora. Though these facts are interesting they do not provide a robust empirical indication of the degree of dependency. For this, we would need an assessment of the lives saved or illness incidents avoided as a result of higher levels of biodiversity and then use appropriate value of statistical life estimates to assess the magnitude of these impacts on human welfare. Such studies are non existent.

5.5 Biodiversity and resilience

The term "resilience" has been used to denote an ecosystem's ability to maintain its basic functions and controls under disturbances (Baumgartner and Strunz 2009, Holling 1973, Carpenter et al. 2001). Higher degree of resilience is found in ecosystems that exhibit higher degrees of biodiversity (see Swift et al (2004) for a review of these studies from an ecological perspective). The economic relevance of ecosystem resilience is obvious, as a system flip may entail huge welfare losses since the continued provision of several key ecosystem services would be at risk of total collapse. For example, a combination of drought, fire and ill-adapted livestock grazing management in sub-Saharan Africa, central Asia and Australia have lead to severe degradation and desertification of semi-arid rangelands that provide subsistence livelihoods for more than one billion people. Once these grasslands are degraded they can no longer be used as pasture (Baumgartner and Strunz, 2009). Hence, resilience is related to the threat of 'irreversible' ecosystem damage.

There is a growing literature that discusses the value of resilience as insurance against irreversible damage. These papers do make specific reference to this value in relation to the world's poor. Yet, the discussion is mainly conceptual and model based (e.g. Baumgartner and Strunz 2009; Baumgartner and Quaas 2008a and 2008b, Maler 2008; Perrings 2006; Perrings and Stern 2000). There are no empirical studies on the degree of dependency on biodiversity as a source of

protection against the risk of declining resilience. This is to be expected, given that resilience is associated with a form of 'wider insurance' against potentially multiple risks. It is also a concept related to 'entire systems' and not specific aspects of biodiversity, and as such is not easy to isolate nor trace back to specific behavioural decisions.

6. CONCLUSIONS

This review has examined the published literature which studies links between biodiversity and poverty. Interestingly, while many papers refer to the existence of such a relationship, there are relatively few studies that subject this relationship to critical empirical scrutiny. One (surprising) finding of our review is that there is such a paucity of grounded empirical information about the particular ways in which people (especially the poor) use and benefit from the existence of biological diversity. However, the studies that do exist point to some interesting patterns which are worthy of generalisation. Indeed, it is not necessarily clear that adding to our stock of case study material would necessarily result in the discovery of a hitherto-unknown dimension of the poverty-biodiversity nexus; many of the current known patterns are likely to be repeated in additional studies. More case studies may add some empirical depth, but are not necessarily going to result in a different conceptualisation of the ways in which poverty and biodiversity are related.

The limited use of the poverty concept in the existing literature was a particular source of disappointment. Here, we would suggest that there are significant missed opportunities, and a more expanded notion of poverty is likely to result in much greater analytical traction for an understanding of the biodiversity-poverty link.

On income and subsistence, our review suggests that there is some evidence supporting the hypothesis that the poor do depend significantly on biodiversity, but this needs to be looked at with some caution. In some cases, there is clear

evidence that the poor make extensive use of their natural resources, as long as these remain relatively low-value and subsistence oriented, but there is also evidence that these same groups either lose access or are actively excluded from more highly valued resource uses. This suggests that there is some evidence of a possible 'poverty trap', with poorer users stuck in low value extractive uses but unable to make the transition out of this resource dependent mode.

There is relatively robust information to show that the poor rely on farm agro-biodiversity to insure against food (in)security and risk. However, we still know very little empirically about the significance of other forms of biodiversity in terms of risk insurance, protection against natural hazards, health and ecosystem resilience. This is an important knowledge gap, and our review points to the need for more systematic and robust studies which examine these linkages in greater depth.

Appendix

Table A1: List of Detailed Case Studies

Reference	Region	Resource	Activity	Aspect	Dimension
Adhikari et al 2004	South Asia	Forests	Multiple	Incidence	Income
Babulo et al 2008	East Africa	Forests	Multiple	Incidence	Income
Bahuguna 2000	South Asia	Forests	Multiple	Not specified	Not specified
Bene et al 2009	West Africa	Fish	Multiple	Incidence	Income
Cavendish 2000	Southern Africa	Multiple	Multiple	Incidence	Income
Coomes et al 2004	Latin America	Multiple	Multiple	Incidence	Income
Coulibaly et al 2009	West Africa	Forests	Multiple	Not specified	Not specified
de Merode et al 2004	West Africa	Wild animals	Multiple	Incidence	Income
Dovie et al 2007	Southern Africa	Wild plants	Subsistence consumption	Incidence	Income
Fisher 2004	Southern Africa	Forests	Multiple	Incidence	Income
Fu et al 2009	Other Asia	Other NTFP	Multiple	Incidence	Income
Glaser 2003	Latin America	Mangroves	Multiple	Incidence	Income
Jha 2009	South Asia	Forests	Multiple	Incidence	Income
Jodha 1990	South Asia	Multiple	Multiple	Incidence	Income
Kamanga et al 2009	Southern Africa	Forests	Multiple	Incidence	Income
Levang et al 2005	South-east Asia	Forests	Multiple	Incidence	Income
Mamo et al 2007	East Africa	Forests	Multiple	Incidence	Income
Narain et al 2008a	South Asia	Multiple	Multiple	Equality	Income

Narain et al 2008b	South Asia	Multiple	Multiple	Incidence	Income
Osemeobo 2005	West Africa	Wild plants	Multiple	Not specified	Not specified
Paumgarten & Shackleton 2009	Southern Africa	Other NTFP	Multiple	Incidence	Income
Reddy and Chakravarty 1999	South Asia	Forests	Multiple	Equality	Income
Sapkota and Oden 2008	South Asia	Forests	Multiple	Incidence	Income
Shaanker et al 2004	South Asia	Other NTFP	Multiple	Incidence	Income
Shackleton & Shackleton 2006	Southern Africa	Other NTFP	Multiple	Incidence	Income
Sharma et al 2009	South Asia	Forests	Multiple	Incidence	Income
Viet Quang and Anh 2006	South-east Asia	Other NTFP	Multiple	Incidence	Income

Table A2: Findings from detailed case studies

Reference	Region	Explanatory factors	Extent of dependence	Relative dependence	Inequality
Adhikari et al 2004	South Asia	Education reduces dependence; complementary productive assets: livestock and land increase use		Tree/grass fodder leaf litter increases with wealth; fuelwood does not vary (slight increase with wealth, not statistically sig.)	Female-headed, lower caste collect less
Babulo et al 2008	East Africa	Lack of education, female headed, lack of land, access to credit, roads, livestock increases dependence		Poverty trap: forest dependence inferior	
Bahuguna 2000	South Asia		48.7% of total income from forests, mainly fuel, fodder and employment		
Bene et al 2009	West Africa	Periodic use: fish as bank in the water	Consumption: Q1 33%, Q2/Q3 23%, Q4 20%; income Q1 90%, Q2 67%, Q3 64% Q4 63%, 29.7% fish only source of cash income	Poor more dependent on fish for income, consumption	98.6% men, 69% women sell fish;
Cavendish 2000	Southern Africa		Env income 35.4% in 93-94, 36.9% in 96-97	Poor more dependent than rich; quantity consumed increases with income; cash income falls with welath (93;94: lowest quintile 50%, middle 60% ±30%; richest 25%; 96-97: 34% poorest, 6% richest)	
Coomes et al 2004	Latin America	Younger hhs, more nets, more members fish more; younger hhs, land, equipment, experience hunt more; species level explanations	66% hhs depend on resource extraction, value 20% of total income	Resource draw not related to poor hhs; reliance for fishing not linked to wealth, reliance on hunting more for land rich hhs, palm fruit reliance declines with	

				wealth, then increases	
Coulibaly et al 2009	West Africa	Age impact depends on product, hh size, ethnicity, land, livestock		Higher incomes increase dependence	
de Merode et al 2004	West Africa	Seasonality of use	Wild foods 31% of hh prodn, 10% of self consn, 24% of sale	Bushmeat, fish consumed/sold less by poor, wild plants more by poor	
Dovie et al 2007	Southern Africa		98% hhs use NTFPs, value USD 559/hh; 91% wild herbs, value USD 167/hh	No association with wealth - all depend	
Fisher 2004	Southern Africa	Lack of land, education, goats reliance on LRFA; lack of education, goats, available male labour, location reliance on HRFA	Forest income 30% of hh income	As income increases, reliance declines for LRFA; reliance increases for HRFA	Addition of forest income reduces inequality by 12%
Fu et al 2009	Other Asia		Income from NTFPs, % of income and dependence more in less developed village	Poor more dependent on NTFP income	
Glaser 2003	Latin America		Over 50% depend on crabs, 30% commercial fishing, 80% on mangroves overall, 68% earn income from mangroves		Pure subsistence products most important for voiceless - women and children
Jha 2009	South Asia		70% depend on beedis or firewood	Dependence decreases with increased income, except beedis which are made by rich	
Jodha 1990	South Asia		Poor: 84-100%, rich 10-19%; overall CPR income 14-23% of total	Poor more dependent	Inclusion of CPR income lowers Gini coefficient
Kamanga et al 2009	Southern Africa	Younger, less educated, more members have greater forest income	Cash income from forests low; Fuelwood 66-78% of forest income	Poor lowest forest income, but poor/medium poor depend more (22%)	Gini coefficient increases with removal of forest

				compared to less poor (9%)	income
Levang et al 2005	South-east Asia	Cash income less in remote areas	72% of hhs depend on forest products, 30% of total income, main cash activity for 16%	Poverty trap - get out of the forest	Dependence high in remote areas because of few options
Mamo et al 2007	East Africa		39% of hh income, firewood most imp (59%); 42% depend on forest for grazing	Poor rely more (59%, while rich 30%) but extract less (95 USD vs 191 USD)	Gini coefficient increases with removal of forest income
Narain et al 2008a	South Asia	Private land holdings reduce need; higher availability of biomass increases dependence	Q1:11.6%; Q2: 8.9%; Q3: 10.9%; Q4: 13%.	Fuel, dung fuel, dung manure declines, fodder, construction wood increases with income	
Narain et al 2008b	South Asia		Middle income hhs most likely to collect	Conditional on collection, rich use more CPRs	At income extremes, bimodal use and dependence
Osemeobo 2005	West Africa		Av value of wild plants/hh: USD11957; net income USD 6743		
Paumgarten & Shackleton 2009	Southern Africa		Negligible effect of wealth on NTFP use; all use	Poor sell more NTFPs, rich sell high value curios	
Reddy and Chakravarty 1999	South Asia		Poverty increases if forestry income set to zero	Poorest of the poor disproportionately dependent	Inequality increases if forestry income not included
Sapkota and Oden 2008	South Asia	Proximity to source		Share of fuelwood from CF higher for poor	Lower castes more dependent
Shaanker et al 2004	South Asia		3 sites: 16%, 24%, 59% of cash income	Decreased with increase in weath index	Inclusion of NTFP income lowers Gini coefficient
Shackleton & Shackleton 2006	Southern Africa			Poor more involved in sale of NTFPs; per capita consumption of fuelwood and edible herbs greater for	

				poor, but no difference for grass brushes	
Sharma et al 2009	South Asia		75% of fuel and fodder from forest	Poor more dependent	
Viet Quang and Anh 2006	South-east Asia	Urban proximity	30% of hhs: NTFP income over 50% of total; further 15%, NTFP income 25-50% (all poorest)	Poor more dependent	

REVIEWED LITERATURE

Adams, W. M., R. Aveling, et al. (2004). "Biodiversity Conservation and the Eradication of Poverty." Science **306**(5699): 1146-1149.

Addison, T., D. Hulme, et al. (2009). Poverty Dynamics: Interdisciplinary Perspectives. Oxford, Oxford University Press.

Adhikari, B., S. Di Falco, et al. (2004). "Household characteristics and forest dependency: evidence from common property forest management in Nepal." Ecological Economics **48**(2): 245-257.

Agrawal, A., and K. Redford. (2006). "Poverty, development and biodiversity conservation: shooting in the dark." Working Paper No. **26**. Wildlife Conservation Society.

Akinnifesi, F., H. Waibel and D. Mithöfer (2006). "The role of food from natural resources in reducing vulnerability to poverty: a case study from Zimbabwe," Proceedings of the German Development Economics Conference, Berlin 2006 28, Verein für Socialpolitik, Research Committee Development Economics.

Alix-Garcia, J. (2008). "An exploration of the positive effect of inequality on common property forests." Journal of Development Economics **87**(1): 92-105.

Altieri, M.A. (1999). "The ecological role of biodiversity in agroecosystems." Agriculture, Ecosystems and Environment **74**, 19–31.

Anderson, S. (2003) "Animal genetic resources and sustainable livelihoods." Ecological Economics, **45(3)**: 331-339.

Angelsen, A. and S. Wunder (2002). "Exploring the Forest-Poverty Link." CIFOR Occasional Paper **40**.

Arnold, J.E.M. and P. Bird (1999). "Forests and the Poverty-Environment Nexus." Paper prepared for the UNDP/EC Expert Workshop on Poverty and the Environment, Brussels, Belgium, January 20-21, 1999.

Ash, N. And M. Jenkins (2007). Biodiversity and poverty reduction: the importance of biodiversity for ecosystem services. Cambridge, UNEP-World Conservation Monitoring Centre.

Ashworth, L., M. Quesada, et al. (2009). "Pollinator-dependent food production in Mexico." Biological Conservation **142**(5): 1050-1057.

Austrheim, G. and O. Eriksson (2001). "Plant species diversity and grazing in the Scandinavian mountains - patterns and processes at different spatial scales." Ecography **24**(6): 683-695.

Babulo, B., B. Muys, et al. (2008). "Household livelihood strategies and forest dependence in the highlands of Tigray, Northern Ethiopia." Agricultural Systems **98**(2): 147-155.

Babulo, B., B. Muys, et al. (2009). "The economic contribution of forest resource use to rural livelihoods". Forest Policy and Economics **11**(2): 109-117.

Bahuguna, V. K. (2000). "Forests in the economy of the rural poor: An estimation of the

dependency level." Ambio **29**(3): 126-129.

Baland, J-M. and P. Francois (2005). "Commons as insurance and the welfare impact of privatization." Journal of Public Economics **80**: 211–231.

Barbier, E.B. (2000). "The economic linkages between rural poverty and land degradation: some evidence from Africa." Agriculture, Ecosystems and Environment **82**:355-370.

Barbier, E.B. (2005). "Natural capital, resource dependency and poverty in developing countries: the problem of 'dualism within dualism'". In R. López and M. Toman (eds.), Economic Development and Environmental Sustainability, Oxford: Oxford University Press.

Barbier, E.B. (2007). "Natural capital and labor allocation: Mangrove-dependent households in Thailand." Journal of Environment and Development **16**(4): 398-431.

Bardsley, D. and I. Thomas (2005). "Valuing local wheat landraces for agrobiodiversity conservation in Northeast Turkey." Agriculture, Ecosystems and Environment **106**(4): 407-412.

Baumgartner, S. (2007). "The insurance value of biodiversity in the provision of ecosystem services." Natural Resource Modeling **20**(1): 87-127.

Baumgartner, S. and M. F. Quaas (2008a). "Managing increasing environmental risks through agro-biodiversity and agri-environmental policies," Working Paper Series in Economics 80, University of Lüneburg, Institute of Economics

Baumgartner, S. and M. F. Quaas (2008b) "Agro-biodiversity as natural insurance and the development of financial markets" in Kontoleon, A, U. Pascual and M. Smale (Eds), Agrobiodiversity, Conservation and Economic Development London: Routledge.

Baumgartner S. and S. Strunz (2009) "The economic insurance value of ecosystem resilience." Paper presented at the European Society for Ecological Economics 2009 Conference, Ljubljana, Slovenia.

Bawa, K. S., G. Joseph, et al. (2007). "Poverty, biodiversity and institutions in forest-agriculture ecotones in the Western Ghats and Eastern Himalaya ranges of India." Agriculture, Ecosystems & Environment **121**(3): 287-295.

Bell, J. D., M. Kronen, et al. (2009). "Planning the use of fish for food security in the Pacific." Marine Policy **33**(1): 64-76.

Bellon, M.R. (2004). "Conceptuzing interventions to support on-farm genetic resource conservation." World Development **32** (1):159–172.

Bene, C., E. Steel, et al. (2009). "Fish as the "bank in the water" - Evidence from chronic-poor communities in Congo." Food Policy **34**(1): 108-118.

Bhat, M. G. (1999). "On biodiversity access, intellectual property rights, and conservation." Ecological Economics **29**(3): 391-403.

Biodiversity International (2004). "Why genetic diversity matters." IPGRI, Future Harvest. Rome.

Biodiversity International (2005). "Agricultural biodiversity and elimination of hunger and poverty: UN Millennium Development Goals, five years later." The Chennai Platform for Action. GFU, IPGRI, M.S. Swaminathan Research Foundation. Rome

Birol, E., E. Villalba and M. Smale (2009). "Farmer preferences for milpa diversity and genetically modified maize in Mexico: a latent class approach." Environment and Development Economics **14**(4): 521-540.

Birol, E., M. Smale and Á. Gyovai (2006). "Using a choice experiment to estimate farmers' valuation of agrobiodiversity on Hungarian small farms." Environmental and Resource Economics **34**(4): 439-469.

Borner, J., J. Mburu, et al. (2009). "Assessing opportunity costs of conservation: Ingredients for protected area management in the Kakamega Forest, Western Kenya." Forest Policy and Economics **11**(7): 459-467.

Bromley, D. W. and J.-P. Chavas. (1989). "On risk, transactions and economic development in the semi-arid tropics." Economic Development and Cultural Change **37**: 719-736.

Brookfield, H. (2001). Exploring Agrodiversity, New York: Columbia University Press.

Brookfield, H. and M. Stocking (1999). "Agrodiversity: definition, description and design." Global Environmental Change **9**: 77–80.

Brookfield, H., C. Padoch, H. Parsons and M. Stocking (2002). Cultivating Biodiversity: understanding, analysing and using agricultural diversity. London: The United Nations University, ITDG Publishing.

Brown, K., T. Daw et al (2008). "Ecosystem services for poverty alleviation: marine and coastal situational analysis." Synthesis report, UK Ecosystem Services for Poverty Alleviation (ESPA) Programme.

Brussaard, L., P. C. de Ruiter and G. G. Brown (2007). "Biodiversity for agricultural sustainability." Agriculture, Ecosystems and Environment **121**(3): 193-308.

Burgess, N. D., A. Balmford, et al. (2007). "Correlations among species distributions, human density and human infrastructure across the high biodiversity tropical mountains of Africa." Biological Conservation **134**(2): 164-177.

Burlingame, B. 2000. "Wild nutrition." Journal of Food Composition and Analysis **13**: 99–100.

Cardinale, B.J., A.R. Ives and P. Inchausti. (2004) "Effects of species diversity on the primary productivity of ecosystems: extending our spatial and temporal scale of inference." Oikos **104**: 437- 450.

Cavatassi, R., L. Lipper and J. Hopkins (2006). "The role of crop genetic diversity in coping with agricultural production shocks: insights from Eastern Ethiopia." Working Papers 06-17, Agricultural and Development Economics Division of the Food and Agriculture Organization of the United Nations (FAO - ESA).

Cavendish, W. (2000). "Empirical Regularities in the Poverty-Environment Relationship of Rural Households: Evidence from Zimbabwe." World Development **28**(11): 1979-2003.

Chapin, F.S., E.S. Zavaleta, et al (2000). "Consequences of changing biodiversity." Nature **405**: 234-242.

Chavas, J-P. (2009). "On the productive value of biodiversity." Environmental and Resource Economics **42**: 109-131.

Chimhowu, A. O., K. Rob, et al. (2009). Poverty. International Encyclopedia of Human Geography. Oxford, Elsevier**:** 408-415.

Chivian, E. and A. Bernstein (2004) "Embedded in nature: human health and biodiversity." Environmental Health Perspectives **112**(1): A12-A13.

Chivian, E. and A. Bernstein (Eds) (2008). Sustaining Life: How Human Health Depends on Biodiversity. Oxford: Oxford University Press.

Chopra, K. (1998). "Economic Aspects of Biodiversity Conservation: Micro and Macro Strategies for Intervention." Economic and Political Weekly **33**(52): 3336-3340.

Chowdhury, M. S. H., M. A. Halim, et al. (2007). "Biodiversity use through harvesting faunal resources from forests by the Mro tribe in the Chittagong Hill Tracts, Bangladesh." International Journal of Biodiversity Science and Management **3**(1): 56-62.

Clements, T., A. John, et al. (2010). "Payments for biodiversity conservation in the context of weak institutions: Comparison of three programs from Cambodia." Ecological Economics **In Press, Corrected Proof**.

Conway. G.R. (1993) "Sustainable agriculture: The trade-offs with productivity, stability and equitability." In: Economics and ecology new frontiers and sustainable development, ed. E.D. Barbier. London: Chapman.

Coomes, O. T., B. L. Barham, et al. (2004). "Targeting conservation-development initiatives in tropical forests: insights from analyses of rain forest use and economic reliance among Amazonian peasants." Ecological Economics **51**(1-2): 47-64.

Coulibaly-Lingani, P., M. Tigabu, et al. (2009). "Determinants of access to forest products in southern Burkina Faso." Forest Policy and Economics **11**(7): 516-524.

Cromwell, E. et al (2001). "Biodiversity and livelihoods: issues and entry points for development agencies." in Koziell, Izabella and Jacqueline Saunders (Eds) (2001) Living Off Biodiversity: exploring livelihoods and biodiversity issues in the natural resources management. London:International Institute for Environment and Development.

Daily, G. C. and P.R. Ehrlich (1996). "Impacts of development and global change on the epidemiological environment." Environment and Development Economics **1**(3): 311-346.

Das, S. and Vincent, J.R. (2009) "Mangroves protected villages and reduced death toll during Indian super cyclone". *PNAS* 106(18): 7357-7360.

Dasgupta, P. and A. L. Simon (2001). Economic Value of Biodiversity, Overview. Encyclopedia of Biodiversity. New York, Elsevier**:** 291-304.

Dasgupta, S., U. Deichmann, et al. (2005). "Where is the Poverty-Environment Nexus? Evidence from Cambodia, Lao PDR, and Vietnam." World Development **33**(4): 617-638.

Davidar, P., M. Arjunan, et al. (2008). "Why do local households harvest forest products?

A case study from the southern Western Ghats, India." Biological Conservation **141**(7): 1876-1884.

de Merode, E., K. Homewood, et al. (2004). "The value of bushmeat and other wild foods to rural households living in extreme poverty in Democratic Republic of Congo." Biological Conservation **118**(5): 573-581.

Delang, C. O. (2006a). "Not just minor forest products: The economic rationale for the consumption of wild food plants by subsistence farmers." Ecological Economics **59**(1): 64-73.

Delang, C. O. (2006b) "The role of wild food plants in poverty alleviation and biodiversity conservation in tropical countries." Progress in Development Studies **6**(4): 275-286.

Department for International Development (DFID) (2001) Biodiversity - a crucial issue for the world's poorest, DFID Report https://www.dfid.gov.uk/Documents/publications/biodiversity.pdf

Department for International Development (DFID) (2002a), Poverty and Environment, DFID Report http://www.dfid.gov.uk/Documents/publications/povertyandenvironment.pdf

Department for International Development (DFID) (2002b) Wildlife and Poverty Study. Livestock and Wildlife Advisory Group, Department for International Development, UK.

Dercon, S. (1996). "Risk, Crop Choice and Savings: Evidence from Tanzania." Economic Development and Cultural Change **44**(3):385–415.

Dercon, S. (1998). "Wealth, risk and activity choice: cattle in western Tanzania." Journal of Development Economics **55**: 1-42.

Dercon, S. (2004). "Growth and shocks: evidence from rural Ethiopia." Journal of Development Economics **74**(2):309–29.

Dercon, S. (2005). Insurance Against Poverty. Oxford: Oxford University Press.

Dercon, S. (2006) "Risk, Growth and Poverty: what do we know, what do we need to know?" QEH Working Papers qehwps148, Queen Elizabeth House, University of Oxford.

Dercon, S., and P. Krishnan. (2000). "Vulnerability, poverty and seasonality in Ethiopia." Journal of Development Studies **36**(6):25–53.

Dewi, S., B. Belcher, et al. (2005). "Village economic opportunity, forest dependence, and rural livelihoods in East Kalimantan, Indonesia." World Development **33**(9): 1419-1434.

Di Falco S. and C. Perrings 2005. "Crop biodiversity, risk management and the implications of agricultural assistance." Ecological Economics. **55**(4): 459-466.

Di Falco, S. and J-P. Chavas (2006). "Crop Genetic Diversity, Farm Productivity and the Management of Environmental Risk in Rainfed Agriculture." European Review of Agricultural Economics **33**(3).

Di Falco, S. and J-P. Chavas (2007) "The Role of Crop Diversity in the Management of Environmental Risk" in Biodiversity Economics: Principles, Methods and Applications. A. Kontoleon, U. Pascual and T. Swanson, Editors, Cambridge University Press, Cambridge: 581-593.

Di Falco, S. and J-P. Chavas (2008a). "Diversity, Productivity and Resilience in Agro-Ecosystems: An Example from Cereal Production in Southern Italy." in Kontoleon, A, U. Pascual and M. Smale (Eds), Agrobiodiversity, Conservation and Economic Development, London: Routledge.

Di Falco, S. and J-P. Chavas (2008b). "Rainfall Shocks, Resilience and the Dynamic Effects of Crop Biodiversity on the Productivity of the Agroecosystem." Land Economics **84** (1), 83-96.

Di Falco, S. and J-P. Chavas (2009). On Crop Biodiversity, Risk Exposure and Food Security in the Highlands of Ethiopia. American Journal of Agricultural Economics **91**(3).

Di Falco, S., and C. Perrings (2003). "Crop genetic diversity, productivity and stability of agroecosystems: a theoretical and empirical investigation." Scottish Journal of Political Economy, **50**.

Di Falco, S., J-P. Chavas and M. Smale (2007). "Farmer management of production risk on degraded lands: the role of wheat variety diversity in the Tigray region, Ethiopia." Agricultural Economics **36**(2): 147-156.

Dovie, D. B. K., C. M. Shackleton, et al. (2007). "Conceptualizing the human use of wild edible herbs for conservation in South African communal areas." Journal of Environmental Management **84**(2): 146-156.

Duraiappah, A. K. (1998) "Poverty and Environmental Degradation: A Review and Analysis of the Nexus." World Development **26**(12): 2169-2179.

Ehrlich, P. R. and A. H. Ehrlich (1992). "The Value of Biodiversity." Ambio **21**(3): 219-226.

Ellis, F. and S. Biggs (2001): "Issues in Rural Development Evolving Themes in Rural Development 1950s-2000s." Development Policy Review. **19**(4).

Emerton, L. (2005) "Making the economic links between biodiversity and poverty; the case of Lao PDR." Colombo, IUCN.

Engel, S., S. Pagiola, et al. (2008). "Designing payments for environmental services in theory and practice: An overview of the issues." Ecological Economics **65**(4): 663-674.

Esquinas-Alcázar, J. (2005) "Protecting crop genetic diversity for food security: political, ethical and technical challenges." Nature Reviews Genetics **6**: 946-953.

Evenson, R. E., D. Gollin and V. Santaniello (eds.) (1998). Agricultural values of plant genetic resources. Wallingford, UK: CABI, FAO, University of Tor Vergata, and CABI Publishing.

Fafchamps, M., C. Udry and Czukas, K. (1998). “Drought and saving in West Africa: Are livestock a buffer stock?” Journal of Development Economics **55**: 273-305

Fisher, B. and T. Christopher (2007). "Poverty and biodiversity: Measuring the overlap of human poverty and the biodiversity hotspots." Ecological Economics **62**(1): 93-101.

Fisher, M. (2004). "Household welfare and forest dependence in Southern Malawi." Environment and Development Economics **9**(02): 135-154.

Ford-Lloyd, B.V., D. Brar, G.S. Khush, M.T. Jackson and P.S. Virk (2008) “Genetic erosion over time of rice landrace agrobiodiversity.” Plant Genetic Resources: Characterization and Utilization **7**(2); 163–168 .

Foudi, S. (2008) “Estimating the Interactions of Soil Biota and Agricultural Practices.” in Kontoleon, A, U. Pascual and M. Smale (Eds), *Agrobiodiversity, Conservation and Economic Development*, London: Routledge.

Frison, E., I.F. Smith, T. Johns, J. Cherfas and P. Eyzaguirre (2005). “Using biodiversity for food, dietary diversity, better nutrition and health.” South African Journal of Clinical Nutrition **18**: 112–114.

Fu, Y. N., J. Chen, et al. (2009). "The role of non-timber forest products during agroecosystem shift in Xishuangbanna, southwestern China." Forest Policy and Economics **11**(1): 18-25.

Gauli, K. and M. Hauser (2009). "Pro-poor commercial management of non-timber forest products in Nepal's community forest user groups: Factors for success." Mountain Research and Development **29**(4): 298-307.

Gautam, R., A. Subedi, et al. (2007). Home gardens: On-farm agro-biodiversity conservation unit and source of dietary diversity of rural farmers of Nepal. Proceedings of the 1st International Conference on Indigenous Vegetables and Legumes Prospectus for Fighting Poverty, Hunger and Malnutrition. M. L. Chadha, G. Kuo and C. L. L. Gowda**:** 509-512.

Geldenhuys, C. J. (2007). "Weeds or useful medicinal plants in the rural home garden?" Food and Nutrition Bulletin **28**(2): S392-S397.

Ghate, R., D. Mehra, et al. (2009). "Local institutions as mediators of the impact of markets on non-timber forest product extraction in central India." Environmental Conservation **36**(1): 51-61.

Giller, K.E., M.H. Beare, P.Lavelle, A.M.N. Izac and M.J. Swift(1997) “Agricultural intensification, soil biodiversity and agro-ecosystem function.” Applied Soil Ecology **6**: 3-16.

Giller, P., and G. Donovan (2002). “Biodiversity and Ecosystem Function: Do Species Matter?” Proceedings of the Royal Irish Academy **102**(B3): 129-139.

Gjertsen, H. (2005). "Can Habitat Protection Lead to Improvements in Human Well-Being? Evidence from Marine Protected Areas in the Philippines." World Development **33**(2): 199-217.

Glaser, M. (2003). "Interrelations between mangrove ecosystem, local economy and social sustainability in Caete Estuary, North Brazil." Wetlands Ecology and Management **11**(4): 265-272.

Godoy, R., H. Overman, et al. (2002). "Local financial benefits of rain forests: comparative evidence from Amerindian societies in Bolivia and Honduras." Ecological Economics **40**(3): 397-409.

Goeschl, T and T. Swanson (2000) "The relationship between development and diversity: the case of crop genetic resources." CSERGE Working Paper, UCL London.

Grifo, F. and J. Rosenthal (Eds.) (1997). Biodiversity and Human Health, Washington, DC: Island Press.

Gunderson, L.H. and L. Pritchard Jr. (eds) (2002). Resilience and the Behavior of Large-Scale Systems. Washington, DC: Island Press.

Harkness, J. (1998). "Recent Trends in Forestry and Conservation of Biodiversity in China." The China Quarterly(156): 911-934.

Hartell, J., M. Smale, P.W. Heisey, and B. Senauer. (1997). "The Contribution of Genetic Resources and Diversity to Wheat Productivity: A Case from the Punjab of Pakistan." CIMMYT Economics, Working Paper 97-01. Mexico, D.F.: CIMMYT.

Heal, G. (2000). "Biodiversity in the marketplace." World Economics, **1**(4): 149-177.

Heal, G., B. Walker et al (2004). "Genetic diversity and interdependent crop choices in agriculture," Resource and Energy Economics, **26**(2): 175-184.

Heisey, P. W., M. Smale et al (1997). "Wheat rusts and the costs of genetic diversity in the Punjab of Pakistan." American Journal of Agricultural Economics **79**: 726–737.

Holt-Giménez, E. (2002). "Measuring farmers' agroecological resistance after Hurricane Mitch in Nicaragua: a case study in participatory, sustainable land management impact monitoring." Agriculture, Ecosystems and Environment **93**: 87–105.

Huynen M., P. Martens and R.D. Groot (2004) "Linkages between biodiversity loss and human health: a global indicator analysis." International Journal of Environmental Health Research **14**(1): 13-30.

IPGRI (2004) "Why genetic diversity matters." IPGRI Report.

Jackson, L., K. Bawa et al (2005). Agro-Biodiversity – A New Science Agenda for Biodiversity in Support of Sustainable Agro-ecosystems. Diversitas, Paris, France.

Jackson, L.E., U.Pascual and T. Hodking (2007). "Utilizing and conserving agrobiodiversity in agricultural landscapes." Agriculture, Ecosystems and Environment **121**: 196–210.

Jacobi, J., A. W. Drescher et al (2009). "Agricultural Biodiversity Strengthening Livelihoods in Periurban Hyderabad, India." Urban Agriculture Magazine **22.**

Jansen, H. G. P., J. Pender, et al. (2006). "Policies for sustainable development in the hillside areas of Honduras: A quantitative livelihoods approach." Agricultural Economics **34**(2): 141-153.

Jansen, H. G. P., J. Pender, et al. (2006). "Rural development policies and sustainable land use in the Hillside Areas of Honduras: A quantitative livelihoods approach." Research Report of the International Food Policy Research Institute(147): 1-103.

Jha, S. (2009). "Household-specific variables and forest dependency in an Indian hotspot of biodiversity: challenges for sustainable livelihoods." Environment,

Development and Sustainability **11**(6): 1-9.

Jodha, N. S. (1992). "Common property resources: a missing dimension of development strategies." World Bank Discussion Papers **169**.

Jodha, N. S. (1995). "Common property resources and the dynamics of rural poverty in India's dry regions." Unasylva **180**: 23-29.

Johns, T. (2006). "Agrobiodiversity, diet and human health." In D.I. Jarvis, C. Padoch & D. Cooper, eds. Managing biodiversity in agricultural ecosystems. New York, USA, Columbia University Press.

Johns, T. and P. Maundu (n.d) "Forest biodiversity, nutrition and population health in market-oriented food systems." Available online at http://www.fao.org/docrep/009/a0789e/a0789e08.htm

Johns, T. and P.B. Eyzaguirre (2006). "Symposium on 'Wild-gathered plants: basic nutrition, health and survival Linking biodiversity, diet and health in policy and practice." Proceedings of the Nutrition Society (2006), **65**, 182–189

Johns, T., I.F. Smith and P.B. Eyzaguirre (2006)."Agrobiodiversity, nutrition, and health: understanding the links between agriculture and health," 2020 vision briefs 13(12), International Food Policy Research Institute (IFPRI).

Jusoff, K. and N. M. Majid (1995). Integrating needs of the local-community to conserve forest biodiversity in the state of Kelantan." Biodiversity and Conservation **4**(1): 108-114.

Just, R.E., and W. Candler. (1985). "Production functions and rationality of mixed cropping." European Review of Agricultural Economics **12**:207–31.

Kaimowitz, D. and D. Shiels (2007). "Conserving what and for whom: why conservation should help meet basic human needs in the tropics." Biotropica **39**(5): 567-574.

Kamanga, P., P. Vedeld, et al. (2009). "Forest incomes and rural livelihoods in Chiradzulu District, Malawi." Ecological Economics **68**(3): 613-624.

Keleman, A., H.G. Rano and J. Hellin (2009). "Maize diversity, poverty, and market access: lessons from Mexico." Development in Practice **19**(2): 187-199.

Khan, S. R. and S. R. Khan (2009). "Assessing poverty-deforestation links: Evidence from Swat, Pakistan." Ecological Economics **68**(10): 2607-2618.

Kinsey, B., K. Burger and J.W.Gunning (1998). "Coping with drought in Zimbabwe: survey evidence on responses of rural households to risk." World Development **26**(1): 89-110.

Koziell, I. and J. Saunders (Eds) (2001). Living off Biodiversity: Exploring livelihoods and biodiversity issues in the natural resources management. London: International Institute for Environment and Development (IIED).

Kumar, S. (2002). "Does "Participation" in Common Pool Resource Management Help the Poor? A Social Cost-Benefit Analysis of Joint Forest Management in Jharkhand, India." World Development **30**(5): 763-782.

Kurosaki, T., and M. Fafchamps. (2002). "Insurance market efficiency and crop choices in Pakistan." Journal of Development Economics **67**:419–53.

Lambin, E. et al. (2001). “The causes of land-use and land-cover change: moving beyond the myths.” Global Environmental Change **11**: 261–269.

Langholz, J. (1999). "Exploring the effects of alternative income opportunities on rainforest use: Insights from Guatemala's Maya Biosphere Reserve." Society & Natural Resources **12**(2): 139-149.

Lenne J. and D. Wood. (1999). “Optimizing biodiversity for productive agriculture.” In: Agrobiodiversity: Characterization, utilization and management, Wood D. and Lenne J. (eds.). Wallingford, U.K.: CABI Publishing.

Levang, P., E. Dounias, et al. (2005). "Out of the forest, out of poverty?" Forests, trees and livelihoods **15**(2): 211-235.

Lipper, L. and D. Cooper (2008) “Managing agricultural biodiversity for sustainable use: balancing the benefits in the field.” in Kontoleon, A, U. Pascual and M. Smale (Eds), Agrobiodiversity, Conservation and Economic Development, London: Routledge.

Lipper, L., R. Cavatassi and J. Hopkins (2008) “The role of crop genetic diversity in coping with drought: Insights from eastern Ethiopia.” in Kontoleon, A, U. Pascual and M. Smale (Eds), Agrobiodiversity, Conservation and Economic Development, London: Routledge.

Loreau M, S. Naeem and P. Inchausti (2002). Biodiversity and Ecosystem Functioning: Synthesis and Perspectives. Oxford: Oxford University Press

Loreau, M. and A. Hector. (2001). “Partitioning selection and complementarity in biodiversity experiments.” Nature **412**:72-76.

Loreau, M., S. Naeem et al (2002). “Biodiversity and ecosystem functioning: current knowledge and future challenges” Science **294**(5543): 804- 808.

MacQueen, D., A. Barrance, et al. (2001). "Common problems of the forest-dependent poor and priority research and development themes to address them." International Forestry Review **3**(2): 105-120.

Mainwaring, L. 2001. ‘‘Biodiversity, biocomplexity, and the economics of genetic dissimilarity.’’ Land Economics **77**: 79–93.

Maler, K.-G. (2008). “Sustainable development and resilience in ecosystems.” Environmental and Resource Economics, **39**(1): 17-24.

Mamo, G., E. Sjaastad, et al. (2007). "Economic dependence on forest resources: A case from Dendi District, Ethiopia." Forest Policy and Economics **9**(8): 916-927.

Masozeram M. K., R. Janaki and R. Alavalapati (2004). “Forest dependency and its implications for protected areas management: a case study from the Nyungwe forest reserve, Rwanda.” Scandinavian Journal of Forest Research, **19**(4): 85–92.

McGregor, J. (1995). "Gathered produce in Zimbabwe's communal areas: changing resource availability and use." Ecology of Food & Nutrition **33**(3): 163-193.

McNeely, J.A. and S.J. Scherr (2003) Ecoagriculture: strategies to feed the world and save wild biodiversity. Wasington, DC: Island Press.

McSweeney, K. (2003). “Tropical forests as safety nets? The relative importance of forest product sale as smallholder insurance, Eastern Honduras.” Paper presented at

The International Conference on Rural Livelihoods, Forests and Biodiversity 19-23 May 2003, Bonn, Germany.

McSweeney, K. (2005). "Natural insurance, forest access and compounded misfortune: forest resources in small holder coping strategies before and after Hurricane Mitch, north eastern Honduras." World Development **33**(9): 1453–1471.

Meng, E. C. H., M. Smale et al (2003). "Wheat genetic diversity in China: measurement and cost." in Rozelle, S. D. and Sumner, D. A. (ed.) Agricultural trade and policy in China: issues, analysis and implications. Burlington, Vermont: Ashgate. 251-267

Muhammed, N., F. Haque, et al. (2008). "The role of participatory social forestry in the enhancement of the socio-economic condition of the rural poor: A case study of Dhaka Forest Division in Bangladesh." Forests Trees and Livelihoods **18**(4): 395-418.

Muhammed, N., F. Haque, et al. (2009). "The role of participatory social forestry in the enhancement of the socio-economic condition of the rural poor: A case study of dhaka forest division in bangladesh." Forests Trees and Livelihoods **19**(1): 47-67.

Murniati, D. P. Garrity, et al. (2001). "The contribution of agroforestry systems to reducing farmers' dependence on the resources of adjacent national parks: a case study from Sumatra, Indonesia." Agroforestry Systems **52**(3): 171-184.

Naeem, S., et al. (1994). "Declining biodiversity can affect the functioning of ecosystems." Nature **368**: 734-737.

Narain, U., S. Gupta, et al. (2008a). "Poverty and resource dependence in rural India." Ecological Economics **66**(1): 161-176.

Narain, U., S. Gupta, et al. (2008b). "Poverty and the environment: exploring the relationship between household incomes, private assets, and natural assets." Land Economics **84**(1): 148-167.

Nielsen, M. R. (2006). "Importance, cause and effect of bushmeat hunting in the Udzungwa Mountains, Tanzania: Implications for community based wildlife management." Biological Conservation **128**(4): 509-516.

Ninan, K.N. (2007), The Economics of Biodiversity Conservation – Valuation in Tropical Forest Ecosystems. London: Earthscan.

Ninan, K.N. (ed.) (2009). Conserving and Valuing Ecosystem Services and Biodiversity: Economic, Institutional and Social Challenges, London: Earthscan.

Okello, M. M., S. K. O. Seno, et al. (2009). "Reconciling people's livelihoods and environmental conservation in the rural landscapes in Kenya: Opportunities and challenges in the Amboseli landscapes." Natural Resources Forum **33**(2): 123-133.

Omer, A., U. Pascual and N. Russell (2008*)*. "Biodiversity Conservation and Productivity in Intensive Agricultural Systems, in the Field." in Kontoleon, A, U. Pascual and M. Smale (Eds), Agrobiodiversity, Conservation and Economic Development, London: Routledge..

Omer, A., U. Pascual, and N. Russell (2008). "A note on sustainable agricultural intensification through agro-biodiversity conservation," The School of Economics Discussion Paper Series 0807, Economics, The University of Manchester.

Osemeobo, G. J. (2005). "Living on Wild Plants: Evaluation of the Rural Household Economy in Nigeria." Environmental Practice **7**(04): 246-256.

Ostrom, E. (1990). Governing the commons: the evolution of institutions for collective action. Cambridge: Cambridge University Press.

Ostrom, E.,J. Burger, et al (1999). "Sustainability: revisiting the commons: Local lessons, global challenges."Science, **284**:278–282.

Pagiola, S., A. Arcenas, et al. (2005). "Can payments for environmental services help reduce poverty? An exploration of the issues and the evidence to date from Latin America." World Development **33**(2): 237-253.

Pascual, U and C. Perrings (2007). "Developing incentives and economic mechanisms for in situ biodiversity conservation in agricultural landscapes." Agriculture, Ecosystems and Environment **121**: 256-268.

Pattanayak, S.K. and E. Sills, (2001). "Do tropical forests provide natural insurance? The microeconomics of non-timber forest products collection in the Brazilian Amazon," Land Economics, **77**: 595-612.

Paumgarten, F. and C. M. Shackleton (2009). "Wealth differentiation in household use and trade in non-timber forest products in South Africa." Ecological Economics **68**(12): 2950-2959.

Perrings, C. (1995). "Biodiversity Conservation as Insurance." in T. M. Swanson, ed., The Economics and Ecology of Biodiversity Decline. Cambridge: Cambridge University Press.

Perrings, C. (2001). "The economics of biodiversity loss and agricultural development in low income countries.", in Lee D.R., and Barret C.B. eds. Tradeoffs or Synergies? Agricultural Intensification, Economic Development and the Environment. Wallingford: CABI Publishing.

Perrings, C. (2006). "Resilience and sustainable development." Environment and Development Economics. **11**: 417–427.

Perrings, C. (2007). "Pests, pathogens and poverty: biological invasions and agricultural dependence." in A. Kontoleon, U. Pascual and T. Swanson (eds) Biodiversity Economics: Principles, Methods and Applications. Cambridge: Cambridge University Press.

Perrings, C. and D.I. Stern (2000). "Modelling loss of resilience in agroecosystems: rangelands in Botswana." Environmental and Resource Economics. **16**: 185–210.

Perrings, C., L. Jackson et al (2006) "Biodiversity in agricultural landscapes: saving natural capital without losing interest." Conservation Biology. **20**:263-264.

Pimbert, M. (1999). "Sustaining the Multiple Functions of Agricultural Biodiversity". Gatekeeper Series No 88. IIED, London, UK.

Polasky, S. and A. Solow (1995). "On the value of a collection of species." Journal of Environmental Economics and Management. **29**: 298-303.

Polasky, S., E. Nelson, et al (2005). "Conserving species in a working landscape: land use with biological and economic objectives." Ecological Applications. **15**(4): 1387-1401.

Poole, N. D. (2004). "Perennialism and Poverty Reduction." Development Policy Review **22**(1): 49-74.

Poole, N., R. Gauthier, et al. (2007). "Rural poverty in Mexico: assets and livelihood strategies among the Mayas of Yucatan." International Journal of Agricultural Sustainability **5**(4): 315.

Quaas, M.F. and S. Baumgärtner (2006)."The private and public insurance value of conservative biodiversity management." Working Paper Series in Economics 33, University of Lüneburg, Institute of Economics.

Quaas, M.F. and S. Baumgärtner (2008). "Natural vs. financial insurance in the management of public-good ecosystems." Ecological Economics. **65**(2): 397-406.

Qualset, C.O., P.E. McGuire and M.L. Warburton. (1995) "Agrobiodiversity: key to agricultural productivity." California Agriculture **49**(6): 45-49.

Quang, N. V. and S. Noriko (2008). "Forest allocation policy and level of forest dependency of economic household groups: A case study in northern central Vietnam." Small-scale Forestry **7**(1): 49-66.

Rasul, G., M. Karki, et al. (2008). "The role of non-timber forest products in poverty reduction in India: Prospects and problems." Development in Practice **18**(6): 779-788.

Ravi, S. Bala, I. Hoeschle-Zeledon et al (2006). "Hunger and poverty: the role of biodiversity." Report of an International Consultation on The Role of Biodiversity in Achieving the UN Millennium Development Goal of Freedom from Hunger and Poverty Chennai, India, April 18-19, 2005

Reardon, T. and S. Vosti (1995). "Links between rural poverty and the environment in developing countries: asset categories and investment poverty. World Development **23**(9).

Reddy, S. R. C. and S. P. Chakravarty (1999). "Forest dependence and income distribution in a subsistence economy: Evidence from India." World Development **27**(7): 1141-1149.

Roe, D. (2008) "The origins and evolution of the conservation-poverty debate: a review of key literature, events and policy processes." **Oryx 42**: 491-503.

Roe, D. and J. Elliot (2005). Poverty-Conservation Linkages: A Conceptual Framework, Poverty and Conservation Learning Group.

Roe, D. and J. Elliott (2004). "Poverty reduction and biodiversity conservation: rebuilding the bridges." Oryx **38**(2): 137-139.

Sala, O.E. (2001) "Price put on biodiversity." Nature **412**: 34-36.

Salafsky, N. and E. Wollenberg (2000). "Linking livelihoods and conservation: A conceptual framework and scale for assessing the integration of human needs and biodiversity." World Development **28**(8): 1421-1438.

Salkini, A. K. and E. De Pauw (2009). "The Role of Medicinal Plants in Oak Forests in

Idleb, North-West Syria in improving incomes of the rural poor." In M. Palahi, Y. Birot, F. Bravo and E. Gorriz (eds.) Modelling, Valuing and Managing Mediterranean Forest Ecosystems for Non-Timber Goods and Services. European Forest Institute Proceedings no 57, Joensuu, Finland.

Salzman, J. (2005). "Creating markets for ecosystem services: Notes from the field." New York University Law Review **80**(3): 870-961.

Samal, P. K., L. M. S. Palni, et al. (2003). "Ecology, ecological poverty and sustainable development in Central Himalayan region of India." International Journal of Sustainable Development & World Ecology **10**(2): 157 - 168.

Sanderson, S. (2005). "Poverty and Conservation: The New Century's "Peasant Question?"." World Development **33**(2): 323-332.

Sanderson, S. and K. Redford (2003). "Contested relationships between biodiversity conservation and poverty alleviation." Oryx, **37**: 389–390.

Sanginga, P. C., R. Best, et al. (2004). "Linking smallholder farmers to markets in East Africa: Empowering mountain communities to identify market opportunities and develop rural agroenterprises." Mountain Research and Development **24**(4): 288-291.

Sapkota, I. and P. Oden (2008). "Household characteristics and dependency on community forests in Terai of Nepal." International Journal of Social Forestry **1**(2): 123-144.

Sarker, D. and N. Das (2006). "Social capital and Joint Forest Management programme: A comparative study of female-headed and Joint Forest Protection Committees in West Bengal." Journal of Rural Development **25**(4): 537-563.

Sauer, J. and J.M. Abdallah (2007) "Forest diversity, tobacco production and resource management in Tanzania." Forest Policy and Economics **9**(5): 421-439.

Scherr, S.J. (2000). "A downward spiral? Research evidence on the relationship between poverty and natural resource degradation." Food Policy **25**: 479–498.

Schläpfer, F., M. Tucker and I. Seidl (2002). "Returns from hay cultivation in fertilized low diversity and non-fertilized high diversity grassland." Environmental and Resource Economics. **21**(1): 89-100.

Scoones, I., M. Melnyk and J.N. Pretty (1992). The Hidden Harvest. Wild Foods and Agricultural Systems. A Literature Review and Annotated Bibliography. London: International Institute for Environment and Development.

Shackleton, C. and S. Shackleton (2004). "The importance of non-timber forest products in rural livelihood security and as safety nets: A review of evidence from South Africa." South African Journal of Science **100**(11-12): 658-664.

Shackleton, C. M. and S. E. Shackleton (2006). "Household wealth status and natural resource use in the Kat River valley, South Africa." Ecological Economics **57**(2): 306-317.

Shackleton, C. M., S. E. Shackleton, et al. (2007). "The importance of dry woodlands and forests in rural livelihoods and poverty alleviation in South Africa." Forest Policy and Economics **9**(5): 558-577.

Shackleton, S., B. Campbell, et al. (2008). "Links between the Local Trade in Natural

Products, Livelihoods and Poverty Alleviation in a Semi-arid Region of South Africa." World Development **36**(3): 505-526.

Sharma, C. M., S. Gairola, et al. (2009). "Forest resource use patterns in relation to socioeconomic status." Mountain Research and Development **29**(4): 308-319.

Shone, B. M. and J. L. Caviglia-Harris (2006). "Quantifying and comparing the value of non-timber forest products in the Amazon." Ecological Economics **58**(2): 249-267.

Shrestha, R. K. and J. R. R. Alavalapati (2006). "Linking conservation and development: An analysis of local people's attitude towards Koshi Tappu Wildlife Reserve, Nepal." Environment, Development and Sustainability **8**(1): 69-84.

Sierra, R., F. Rodriguez, et al. (1999). "Forest resource use change during early market integration in tropical rain forests: The Huaorani of upper Amazonia." Ecological Economics **30**(1): 107-119.

Sikor, T. and T. Q. Nguyen (2007). "Why May Forest Devolution Not Benefit the Rural Poor? Forest Entitlements in Vietnam's Central Highlands." World Development **35**(11): 2010-2025.

Smale, M. (2006) Valuing Crop Biodiversity: On-Farm Genetic Resources and Economic Change. Wallingford: CABI Publishing.

Smale, M. and A. Drucker (2008). "Agricultural development and the diversity of crop and livestock genetic resources: a review of the economics literature." in A. Kontoleon, U. Pascual and T. Swanson (eds) Biodiversity Economics: Principles, Methods and Applications. Cambridge: Cambridge University Press.

Smale, M., J. Hartell et al (1998). "The Contribution of Genetic Resources and Diversity to Wheat Production in the Punjab of Pakistan." American Journal of Agricultural Economics **80**:482–93.

Smale, M., J. Singh et al (2008). "Wheat diversity and productivity in Indian Punjab after the Green Revolution." Australian Journal of Agricultural and Resource Economics **52**(4): 419-432.

Smale, M., R.M. Bellon and J.A. Aguirre Gomez (2001). "Maize diversity, variety attributes, and farmers choices in Southeastern Guanajuato, Mexico." Economic Development and Cultural. Change **50**: 201-225.

Spiteri, A. and S. K. Nepal (2008). "Evaluating local benefits from conservation in Nepal's Annapurna Conservation Area." Environmental Management **42**(3): 391-401.

Sreedharan, C. and J. Matta (2010). "Poverty alleviation as a pathway to sustainable forest management." Environment, Development and Sustainability. (in print).

Stanger, T.F., J. Lauer and J-P. Chavas (2008). "Long-term cropping systems: the profitability and risk of cropping systems featuring different rotations and nitrogen rates." Agronomy Journal **100**: 105-113.

Sunderlin, W. D., A. Angelsen, et al. (2005). "Livelihoods, forests, and conservation in developing countries: an overview." World Development **33**(9): 1383-1402.

Sunderlin, W. D., S. Dewi, et al. (2007). Poverty and forests: multi-country analysis of spatial association and proposed policy solutions. Bogor, Indonesia, Center for International Forestry Research (CIFOR).

Sunderlin, W.D., I.A.P. Resosudarmo et al (2000). "The effect of Indonesia's economic crisis on small farmers and natural forest cover in the outer islands." CIFOR Occasional Paper 28(1). Bogor, Indonesia: CIFOR.

Swift, M.J.,A.M.N. Izac and M. van Noordwijk (2004). "Biodiversity and ecosystem services in agricultural landscapes—are we asking the right questions?" Agriculture Ecosystems and the Environment **104**:113-124.

Takasaki, Y., B.L. Barham and O.T. Coomes (2004). "Coping strategies in tropical forests: floods, illnesses, and resource extraction." Environment and Development Economics. **9**(2): 203-224.

Tilman, D. (1996). "Biodiversity: population versus ecosystem stability." Ecology **77**: 350–363.

Tilman, D. and J.A. Downing (1994). "Biodiversity and stability in grasslands." Nature **367**: 363–365.

Tilman, D., D. Wedin and J. Knops (1996). "Productivity and sustainability influenced by biodiversity in grassland ecosystems." Nature **379**:718-720.

Tilman, D., S. Polasky and C. Lehman. (2005) "Productivity and temporal stability in the economies of humans and nature." Journal of Environmental Economics and Management. **49**(3): 405-426.

Tripp, R. and W. van der Heide (1996). "The erosion of crop genetic diversity: challenges, strategies and uncertainties." Natural Resource Perspectives, London: Overseas Development Institute.

Tschakert, P. (2007). "Environmental services and poverty reduction: Options for smallholders in the Sahel." Agricultural Systems **94**(1): 75-86.

Turner, R. K. and B. Fisher (2008) "To the rich man the spoils." Nature **451**: 1067-1068.

Twyman, C. (2001). "Natural resource use and livelihoods in Botswana's Wildlife Management Areas." Applied Geography **21**(1): 45-68.

Uma Shaanker, R., K. N. Ganeshaiah, et al. (2004). "Livelihood gains and ecological costs of non-timber forest product dependence: Assessing the roles of dependence, ecological knowledge and market structure in three contrasting human and ecological settings in south India." Environmental Conservation **31**(3): 242-253.

Upton, C., R. Ladle, et al. (2008). "Are poverty and protected area establishment linked at a national scale?" Oryx **42**(01): 19-25.

Van den Berg, M. (2010). "Household income strategies and natural disasters: dynamic livelihoods in rural Nicaragua." Ecological Economics **69**: 592–602.

Van Dusen E., D. Gauchan and M. Smale, (2007). "Farm conservation of rice biodiversity in Nepal: a simultaneous equation approach." Journal of Agricultural Economics **58**(2): 242-259.

Van Dusen, E. (2000)"In situ conservation of crop genetic resources in a center of diversity." 2000 Annual meeting, July 30-August 2, Tampa, FL, American Agricultural Economics Association.

Van Dusen, E. and J.E. Taylor. (2005). "Missing markets and crop diversity: evidence from Mexico." Environment and Development Economics **10**(4): 513-531.

van Staden, J. (1999). "Medicinal plants in southern Africa: utilization, sustainability, conservation - can we change the mindsets?" Outlook on Agriculture **28**(2): 75-76.

Vedeld, P., A. Angelsen et al (2004). "Counting on the environment: forest incomes and the rural poor." Washington, D.C.: World Bank.

Vedeld, P., A. Angelsen, et al. (2007). "Forest environmental incomes and the rural poor." Forest Policy and Economics **9**(7): 869-879.

Viet Quang, D. and T. Nam Anh (2006). "Commercial collection of NTFPs and households living in or near the forests: Case study in Que, Con Cuong and Ma, Tuong Duong, Nghe An, Vietnam." Ecological Economics **60**(1): 65-74.

Villamor, G. B. and R. D. Lasco (2009). "Rewarding upland people for forest conservation: Experience and lessons learned from case studies in the Philippines." Journal of Sustainable Forestry **28**(3-5): 304-321.

Walker T.S., R. P. Singh and N.S. Jodha (1983). Dimensions of farm level diversification in the semi arid tropics of rural south India. Economic Program Progress report 51 Patancheru, India: ICRISAT.

Walpole, M. and L. Wilder (2008). "Disentangling the links between conservation and poverty reduction in practice." Oryx **42**(4): 539-547.

Weitzman, M. L. (1993). "What to preserve? An application of diversity theory to crane conservation." The Quarterly Journal of Economics **108**: 157-183.

Wells, M. P. (1996). "The social role of protected areas in the new South Africa." Environmental Conservation **23**(4): 322-331.

Widawsky, D., and S. Rozelle. (1998). "Varietal diversity and yield variability in Chinese rice production." In M. Smale, ed. Farmers, Gene Banks, and Crop Breeding . Boston : Kluwer.

Wiggins, S., G. Holt, et al. (2001). "Forest resources, urbanisation and poverty: An interdisciplinary study." Forests Trees and Livelihoods **11**(3): 251-274.

Wilder, L. (2008) "Compendium of case studies, lessons and recommendations linking biodiversity conservation and human needs." Cambridge: Flora and Fauna International.

Wollny, C B. A. (2003). "The need to conserve farm animal genetic resources in Africa: should policy makers be concerned?" Ecological Economics **45**(3): 341-351.

World Bank (2007) Poverty and Environment: Understanding Linkages at the Household Level. World Bank Report, No 40218.

Wunder, S. (2001). "Poverty Alleviation and Tropical Forests--What Scope for Synergies?" World Development **29**(11): 1817-1833.

Zimmerman, F.J., and M.R. Carter (2003). "Asset smoothing, consumption smoothing and the reproduction of inequality under risk and subsistence constraints." Journal of Development Economics **71** (2): 233-260.