Biodiversity conservation and poverty reduction: what's the connection?

A systematic mapping of the evidence

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About the authors

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Acknowledgements

The research methods and the findings presented in this report have been published in the journal Environmental Evidence and the original articles are available to download here:

Research protocol: environmentalevidencejournal.org/content/2/1/8

Research results: environmentalevidencejournal.org/content/3/1/3

The discussion on what constitutes good evidence was published in more detail as a Poverty and Conservation Learning Group (PCLG) Discussion Paper and is available to download here: http://pubs.iied.org/G03715.html

Contents

In brief

Assumptions

There is an explicit assumption in international policy statements that conserving biodiversity can help in efforts to tackle global poverty. For example, Parties to the UN Convention on Biological Diversity agreed in 2001 "to achieve by 2010 a significant reduction of the current rate of biodiversity loss… as a contribution to poverty alleviation…". This is mirrored by the inclusion of biodiversity indicators as one element of measuring progress against the Millennium Development Goals (MDGs). A high level meeting at the September 2010 UN General Assembly further stressed the link, claiming "…preserving biodiversity is inseparable from the fight against poverty". But this relationship is not a self-evident truth, and it is important to understand what evidence underlies these claims. Through a systematic mapping of the literature-based evidence, we set out to investigate and identify gaps in the evidence that should be filled so that synergies between conservation and development may be maximised.

What is biodiversity?

Biodiversity is one of those words that means different things to different people — nature, wildlife, rare species. But biodiversity is also a scientific term that encompasses the whole variety of life on Earth at every scale. It is more than wildlife, more than nature even. Biodiversity ranges from individual genes to entire ecosystems. According to the international Convention on Biological Diversity (CBD), biodiversity is "the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems". For the purpose of this review we were mainly interested in natural habitats and wild species rather than all living organisms.

What is poverty?

Poverty is another term with many different definitions. The simplest usually relate to some level of material wealth. For example, the first Millennium Development Goal of eradicating "extreme poverty" aims to improve life for the billion plus people whose income is less than US$1 a day. However, poor people often do not define themselves in cash income terms.

In many cases, issues such as power and voice, opportunity and a healthy environment are valued more highly than money. So it has become increasingly recognised that poverty is multi-dimensional. The World Bank, for example, describes poverty as "a pronounced deprivation in well-being… To be poor is to be hungry, to lack shelter and clothing, to be sick and not cared for, to be illiterate and not schooled." Our study aimed to capture information on these different dimensions of poverty.

What is evidence?

Using rigorously obtained evidence to inform decision-making — something that has long been standard practice in medicine — has rapidly gained popularity in a range of different domains, including international development and biodiversity conservation. So what is evidence? Wikipedia defines evidence as "everything that is used to determine or demonstrate the truth of an assertion". This gives a lot of flexibility: information ranging from professional science reported in peer-reviewed journal articles to indigenous knowledge passed on orally can qualify as evidence.

There is considerable debate, however, as to which types of evidence are the 'best'. Medicine, for example, puts a lot of emphasis on the methods used to gather evidence and gives the most weight to evidence derived from quantitative, randomised, replicated trials that isolate and 'control' variables so their effects can be separately investigated. Evidence that is qualitative or does not have controls is given progressively less weight. But for situations that do not lend themselves to laboratory conditions, such rigorous scientific evidence is more difficult to obtain. A further challenge is how to assess and incorporate evidence that is not generated through a scientific process at all, such as evidence from traditional or indigenous knowledge.

The evidence we collected

Time and funding — the usual constraints any research project — limited our review of the links between biodiversity use and poverty to evidence that was already documented. And of course we had to be able to find the evidence in order to review it. This is where academic journal articles come into their own, since they are catalogued and easily retrievable from a variety of online databases. Experience from field practitioners, funders and poor people themselves is often un-documented (and even when it is documented, it can be hard to locate and retrieve in any systematic fashion). So our review was limited to evidence from formal literature — predominantly from scientific journals. Nevertheless, even within those constraints it revealed some interesting insights into what has been documented to date and where the key knowledge gaps remain.

What the evidence said

We identified just under 400 studies that described poor people using biodiversity in some way. These were widely distributed, covering 27 countries from Africa, 16 from Asia, 13 from Latin America and 3 from Oceania. Ecological distribution was less well spread, however, with over half the papers focussing on forests and very few on mountains, deserts and artificial/exotic habitats. We found studies covering many different components of biodiversity use from genes to ecosystems but the most common focus was on a particular type of resource (for example trees or fish or medicinal plants) rather than on a named species or ecosystem. Non-timber forest products (NTFPs) were the most commonly studied component of biodiversity. And in most cases, it was the abundance or amount of these resources that made them important to poor people rather than anything to do with their variability.

The literature we reviewed noted biodiversity contributing to multiple different dimensions of poverty, but the most commonly cited contribution was to cash income. Other commonly studied dimensions were food security and asset accumulation, while the least commonly studied were energy, shelter and safe water. By far the most frequently recorded way for biodiversity and poverty to interact was through direct (ie extractive) use, for example harvesting NTFPs for household consumption or to sell. We identified remarkably few studies that documented biodiversity's role in underpinning crucial ecological processes and then drew conclusions about how these processes affect poor people's lives.

Overall, the evidence strongly suggested a positive contribution of biodiversity to poverty alleviation. Having said that, it was notable that around a third of those studies reporting a benefit for poor people provided no measure or justification of that contribution (such as any measured increase in income earned, or improvements in food security). And very few studies documented any causal link between biodiversity use and reduced poverty. In other words, most studies documented how the poor use, or are exposed to biodiversity, but did not assess how a change in biodiversity affected levels of poverty or well-being. So even these documented studies do not constitute really good evidence for the apparently self-evident truth that biodiversity helps alleviate poverty. And in fact, as noted below, biodiversity can even sometimes make things worse.

Gaps in the evidence

Our review highlighted a number of gaps in the evidence base on how biodiversity affects poverty. More research — or better documentation — is needed in these areas.

1) Biodiversity is more than a good. Most of the studies that we found framed biodiversity in terms of its value as a resource — in the form of specific goods that can be used to generate tangible benefits such as cash, food and fuel. Very few studies explored biodiversity's role in underpinning the ecosystem services poor people particularly rely on. Even fewer investigated the benefits of diversity as a form of insurance or adaptive capacity.

2) Biodiversity can be bad. Our review highlighted some examples of conflict between biodiversity (wildlife) and people, such as elephants raiding crops; lions killing livestock; apes injuring people. But it only scratched the surface in terms of the inconvenient truth that biodiversity can be your safety net yet it can also kill you. (Our review did not look for studies of how parasites, pathogens and disease vectors affect poor peoples' livelihoods, but it is worth remembering that these too are living organisms and so count as biodiversity according to the CBD definition.)

3) While there is a large body of literature related to forest biodiversity, and especially to NTFPs, other ecological settings are poorly studied. Drylands, in particular, are home to a high proportion of the world's poor, and these people's livelihoods depend on land and livestock. The importance of biodiversity — for fodder, fibre and medicines — seems obvious and warrants increased attention in development strategies for these areas.

4) Just as certain ecosystems are more popular research topics than others, so are the more tangible components of biodiversity. We found few studies that dealt with genetic diversity, microbes or even invertebrates. The studies that have been undertaken to date barely scratch the surface in terms of the full complement of biodiversity.

Lack of evidence doesn't equate to a lack of linkages

So, is conserving biodiversity inseparable from the fight against poverty? Our review revealed a surprisingly patchy evidence base to support this claim. This is not to say that the lack of evidence disproves the claim, but only a very small subset of biodiversity has actually been studied. And, where research has been done, very little has been structured to demonstrate causal links between using biodiversity and alleviating poverty. What's more, there is potentially a vast body of knowledge —held by poor people themselves — that is not documented and is therefore unavailable for evidence reviews such as ours, or for influencing policy.

Policy-makers need to be aware of this evidence bias when formulating conservation and development policy — such as that which will be enshrined in the SDGs. The scientific community can help to address the bias by paying greater attention to those components of biodiversity which are under-studied. But both policy-makers and scientists need to give attention to how to better-integrate the documented and undocumented, and the 'scientific' and 'traditional', in order to generate a much richer evidence base. We are not alone in drawing this conclusion. The newly established Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES) is mindful of the need to recognise multiple forms of evidence. At its second meeting in December 2013 it established a task force on indigenous and local knowledge systems that plans to develop a set of procedures for dealing with these systems in its scientific assessments. But such principles and guidelines must not be confined to improving IPBES assessments. A widespread effort is needed to make the evidence base on biodiversity and poverty both broader and stronger in order that policy-making at all levels — from international to local — is better informed.

1
Introduction

1.1   Biodiversity conservation and poverty reduction: links in policy and practice

Biodiversity conservation and poverty alleviation are both important societal goals attracting increasing international attention. At first glance they may appear to be separate policy realms with little connection. The Convention on Biological Diversity (CBD), agreed in 1992, was drafted in response to escalating biodiversity loss and provides an international policy framework for biodiversity conservation activities worldwide. The OECD International Development Targets of 1996 — reiterated as the Millennium Development Goals (MDGs) in 2000 — focus international development efforts on global poverty alleviation.

However, there is an explicit assumption that conserving biodiversity (or reducing the rate of biodiversity loss) can help in efforts to tackle global poverty and enhance human wellbeing. Evidence of this assumption lies in the target that parties to the CBD agreed 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" (SCBD 2002). The development community also bought into this assumption. For example, when the Millennium Development Goals (MDGs) were formulated in 2000, Goal 7 included a target to "reverse the loss of environmental resources", one indicator of which was the area of land under protection for biodiversity conservation. Subsequently, following the 2006 UN General Assembly, the CBD "2010 Target" was included within MDG7, with additional biodiversity indicators (United Nations 2008).

The reduction in the rate of biodiversity loss anticipated in the 2010 target was not achieved (Butchart *et al.* 2010; Mace *et al.* 2010). This continued loss of biodiversity is lamented not just for its own sake but for its potential implications for continued human wellbeing and poverty reduction. The 2010 progress report on the MDGs noted that "The

irreparable loss of biodiversity will also hamper efforts to meet other MDGs, especially those related to poverty, hunger and health, by increasing the vulnerability of the poor and reducing their options for development" (United Nations 2010a). A high level meeting at the September 2010 UN General Assembly further stressed the linkage, stating that "preserving biodiversity is inseparable from the fight against poverty" (United Nations 2010b). The CBD's latest Strategic Plan (2011-2020), agreed at the 10th Conference of Parties in Nagoya, Japan, continues to emphasise the link between achieving conservation goals and reducing poverty: its mission being to "take effective and urgent action to halt the loss of biodiversity in order to ensure that by 2020 ecosystems are resilient and continue to provide essential services, thereby securing the planet's variety of life, and contributing to human well-being, and poverty eradication" (SCBD 2010).

At some levels the importance of biodiversity to human wellbeing is absolute — biodiversity underpins the delivery of essential ecological services[1] on which the whole of humanity is dependent. But the relationship is certainly not straight forward or linear. Commentators have noted the dynamic and context-specific nature of the biodiversity conservation-poverty alleviation relationship (Kepe *et al*. 2004) and have suggested that factors such as individual access to and control over resources, policies on poverty and biodiversity protection, and population growth and density, are critical in determining whether or not the existence or use of biodiversity leads to poverty reduction (Tekelenberg *et al*. 2009).

1.2 Research objectives

Our research was stimulated by an interest in better understanding the evidence behind the broad claims made by the United Nations and others about the role of biodiversity in contributing to poverty alleviation. We attempted to do this by disaggregating the terms and exploring which particular components or attributes of biodiversity are important to poor people and in what ways.

Biodiversity is defined by the CBD as "the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems". This focus on variability is often missing, however, when assertions such as those above are made. The term biodiversity is often used to refer to the amount (in terms of abundance or biomass) of species or resources, or the extent of habitat rather than diversity per se (Leisher *et al*. 2013; Vira and Kontoleon, 2013). Poverty is another term with many different definitions. The simplest usually relate to some level of material wealth — for example the Millennium Development Goal to "eradicate extreme poverty" refers to the billion-plus people whose income is less

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1.   Such as the production of food and water; the control of climate and disease; nutrient cycles and crop pollination; and cultural benefits.

than US$1 a day. However, poor people often do not define themselves in cash income terms — indeed the concept of cash is completely meaningless for some indigenous communities who live outside of the cash economy. It has therefore become increasingly recognised that poverty is multi-dimensional. The World Bank, for example, describes poverty as 'to be hungry, to lack shelter and clothing, to be sick and not cared for, to be illiterate and not schooled' (World Bank 2001) while Sen discusses poverty in terms of capabilities to fulfil a productive life including good health, access to education and political freedom (Sen 1999). This conceptualisation of poverty is similar to that of human well-being, and indeed, poverty can be thought of as the opposite — or absence — of wellbeing (Millennium Ecosystem Assessment 2005).

The overall objective of our review was to describe the current state of the evidence base on biodiversity-poverty links. In particular we set out to explore the degree to which it disaggregates biodiversity and poverty, its representativeness, the types of linkages that have been found, and the methods that have been used to analyse them. Figure 1 provides a conceptual framework diagram for the review.

Figure 1: Conceptual framework for reviewing biodiversity-poverty linkages
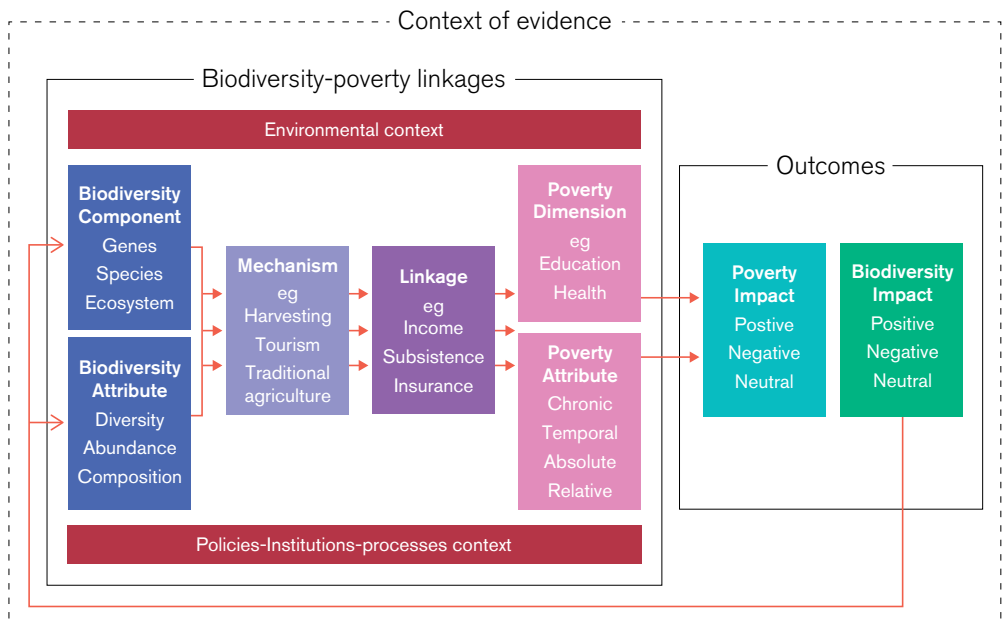
2

What is evidence?

Before discussing our research methods and findings, it is perhaps useful to step back a moment and to consider what is evidence and what constitutes 'good' evidence in the context of investigations into biodiversity and poverty linkages.

2.1 The evolution of evidence-based approaches in biodiversity and poverty research and policy

Over the last decade, donors and decision makers have become increasingly concerned about the likelihood that the policies and projects they support will succeed (Campbell, Benita *et al.* 2007). Where once received wisdom or a convincing logical case was sufficient, there is now an increasing requirement for robust evidence that an intervention works before it is supported. Decisions taken in the light of such evidence are considered to be evidence-based, and it is now common to hear this terminology applied to policy and practice in a range of different fields.

The concept of evidence-based practice originates from medicine, where the increasing use of evidence to inform decisions is believed to have underpinned a revolutionary improvement in performance (reviewed by Pullin and Knight 2001). The concept of evidence-based policy and practice is intuitively appealing, and has rapidly gained popularity in a range of different domains — including in international development and biodiversity conservation.

2.2 What constitutes 'good' evidence?

Wikipedia defines evidence as "everything that is used to determine or demonstrate the truth of an assertion" (http://en.wikipedia.org/wiki/Evidence). This leaves a lot of flexibility in determining what sort of information might qualify as evidence for any given assertion. When considering biodiversity, ecosystem services and poverty alleviation, there are many potential sources of information. The 'ultimate' sources of evidence are the different approaches to knowledge generation that can be used to generate evidence. These range from formalised science through to informal and 'local' knowledge. 'Proximate' sources of evidence are the specific ways in which evidence can be accessed — for example through peer reviewed journal articles, websites, grey literature, oral communication or direct observation. There is, however, much discussion — and little consensus — as to which types of knowledge provide the 'best' evidence. This is clearly not a black and white issue. In the evidence-based medicine literature, a lot of emphasis in answering this question is put on the type of methodology used to gather evidence. This gives the most weight to evidence derived from quantitative, randomised, replicated, controlled trials, and progressively less weight to different forms of evidence that are qualitative or do not have controls. To date, this approach has also been favoured by those promoting evidence-based conservation (Sutherland, Pullin *et al*. 2004; Segan, Bottrill *et al*. 2011).

The natural conclusion of the decision to give greater weight to particular forms of evidence is that there exists an 'evidence hierarchy'. This is explicitly the case in much writing on evidence-based medicine. For example, Petticrew and Roberts (2003) consider the following to be a standard evidence hierarchy for medicine:

1) Systematic reviews and meta-analyses

2) Randomised controlled trials with definitive results

3) Randomised controlled trials with non-definitive results

4) Cohort studies

5) Case-control studies

6) Cross sectional surveys

7) Case reports

Whilst the hierarchy approach is appealing, it has been noted that the most appropriate form of evidence will vary depending on the question that is being asked (Petticrew and Roberts 2003). So for example, a randomised replicated trial might be an appropriate method for answering a question about the fundamental ecology of an ecosystem, but a qualitative, case study approach might be more appropriate for a question about the influence of political incentives on a system of governance (Adams and Sandbrook 2013). One approach that combines the underlying notion of a hierarchy of evidence with the recognition that this hierarchy will vary with the nature of the question is the 'evidence matrix' or 'evidence typology' (Petticrew and Roberts, 2003; Figure 2).

Figure 2: An example of a typology of evidence, after Petticrew & Roberts 2003

Research question	Qualitative research	Survey	Case-control studies	Cohort studies	RCTs	Quasi-experimental studies	Non experimental evaluations	Systematic reviews
Effectiveness Does this work? Does doing this work better than doing that?				+	++	+		+++
Process of service delivery How does it work?	++	+					+	+++
Salience Does it matter?	++	++						+++
Safety Will it do more harm than good?	+		+	+	++	+	+	+++
Acceptability Will children / parents be willing to or want to take up the service offered?	++	+			+	+	+	+++
Cost effectiveness Is it worth buying this service?					++			+++
Appropriateness Is this the right service for these children?	++	++						++
Satisfaction with the service Are users, providers, and other stakeholders satisfied with the service?	++	++	+	+				+

It is often argued that to be convincing, evidence must be based on the comparison of controls to test cases. This follows the logic that without a control it is not possible to know whether an observed effect is due to an intervention or some other third-party factor. The matrix approach introduces the possibility that the need for evidence with controls will be greater for some questions than others. So for example, a scientific question about ecology might be answered through an experimental manipulation involving controls, whereas a question about the influence of political incentives may not be amenable to an experiment-with-controls approach.

Another factor that can be used to assess the strength of evidence is the degree of consistency or agreement between different sources. This approach is used by the IPCC in its assessments of the evidence for climate change (Mastrandrea, Field *et al.* 2010). Figure 3 shows the way in which the IPCC combines information on the type, amount, quality and consistency of each source of evidence with the agreement between sources to identify the level of confidence provided by the overall evidence available.

Figure 3: A depiction of evidence and agreement statements and their relationship to confidence. Confidence increases towards the top-right corner as suggested by the increasing strength of shading. Generally, evidence is most robust when there are multiple, consistent independent lines of high-quality evidence (after Mastrandrea *et al.* 2010)
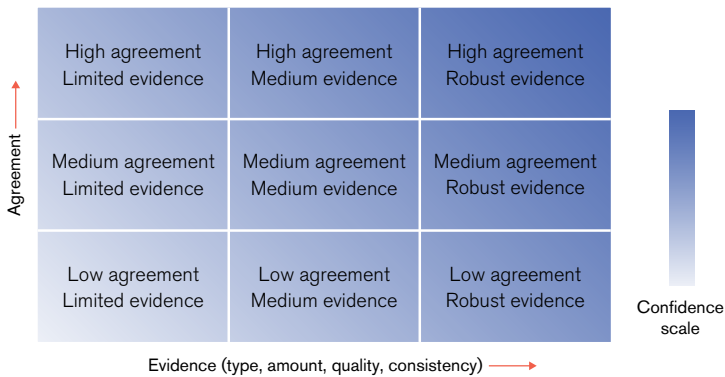
2.3 Integrating evidence from different sources

A particular challenge when assessing evidence is how to incorporate information from a range of different proximate and ultimate sources. The hierarchy, matrix and agreement approaches are mostly targeted at evaluating scientific evidence that has been generated using different methodologies. This is challenging, but nowhere near as challenging as deciding how to incorporate indigenous knowledge that may be based on an entirely different worldview (eg West 2005; Raymond, Fazey *et al.* 2010). This is a problem that is currently being addressed by the new Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), which has set out to incorporate local and indigenous knowledge into its assessments (Tengö, Kvarnström *et al.* 2011). At its second meeting in December 2013 it established a task force on indigenous and local knowledge systems that plans to develop a set of procedures for dealing with these systems in its scientific assessments.

The most common approach used to integrate evidence for evidence-based policy or practice is the systematic review. These are highly structured reviews of existing evidence that follow a defined methodology, making them replicable and reducing the risk of researcher bias influencing the findings of the review. Before conducting a systematic review, the reviewer(s) must make a decision about what kind of evidence to include. This decision will inevitably be based on two factors. First, there are theoretical questions regarding the most appropriate forms of evidence for the question in hand (as reviewed above). Second, there are pragmatic constraints placed upon the reviewer by the time and resources they have available to them (Hagen-Zanker *et al.* 2012). Often it is this second factor that determines the extent to which more difficult sources of evidence, such as indigenous knowledge, are incorporated into reviews, because it simply isn't possible to go and ask indigenous people for their views given the resources available. This was certainly the case for our review of evidence on biodiversity-poverty linkages discussed in this report.

3

Methods

The method used for undertaking a review on the evidence base on biodiversity-poverty linkage was systematic mapping. Systematic mapping is intended to provide an overview of evidence on broad topics — to describe the nature, volume and characteristics of research in a chosen field (Clapton *et al*. 2009, Randall and James 2012). Systematic maps can be used as a tool for identifying where studies would lend themselves to robust synthesis, for example through a systematic review, and to identify knowledge gaps to inform new research initiatives.

Our interpretation of the term biodiversity in the context of our review merits some discussion. As we note above, the CBD definition of biodiversity encompasses "living organisms from all sources". For the purposes of the map, however, we were predominantly interested in natural habitats and wild species — what Balmford *et al*. (2002) describe as "wild nature" — rather than all living organisms. The line between what is wild and what is not is, however, very fuzzy. For example, we did not include mainstream agricultural crops in our interpretation of biodiversity but we did include indigenous varieties of crops and crop wild relatives, or locally domesticated wild species. Similarly, we did not include modern livestock as a component of biodiversity but we did include traditional breeds or landraces.

We also did not want to conduct a study on the health impacts of living pathogens so our interpretation of biodiversity also omitted micro-organisms, parasite and disease vectors such as mosquitoes. We recognise, however, that the impact of such living organisms on poverty is probably far more significant than of any other component of biodiversity.

Finally, much has been written about the varied and complex inter-linkages between biodiversity and ecosystem services. In this review we have not covered the broad ecosystem service literature but only where a study has specifically linked the provision of a specific ecosystem service with particular components of biodiversity. Mace *et al*. (2012) identify three different roles for biodiversity in ecosystem services: as a regulator

of ecosystem processes; as a final ecosystem service; and as a good. Our review has encompassed studies on biodiversity in each of these roles but within that has predominantly adopted what Mace *et al*. would refer to as a "conservation perspective" where the focus is on "a subset of biodiversity that includes charismatic species and those on threatened species lists." Specifically, we focussed on a subset of biodiversity that is predominantly wild (or at least not domesticated to an industrial scale) and of a predominantly larger than micro-organisms scale (but not ignoring wild genetic resources).

3.1 Literature searches

Because we were interested in disaggregating broad claims about biodiversity and poverty we developed an extensive set of search terms that described different components of biodiversity and different dimensions of poverty. Our research protocol (Roe *et al*. 2013) describes in detail the precise steps we followed to develop and test the search terms. Annex 1 summarises the evolution of the final search string.

Our key sources of data were two online databases of peer-reviewed publications: SciVerse's SCOPUS[2] and ISI's Web of Science[3] both of which cover natural and social sciences. To cross-check the publications database searches, Google Scholar was searched just using the terms: "biodiversity" OR "wildlife" AND "poverty" OR "livelihoods" OR "poor". The first 50 'hits' were compared with the Web of Science and Scopus search returns to test their comprehensiveness. References returned by the Google Scholar search, but not found in the Web of Science and Scopus searches, were added to the reference list.

Finally, a sample of the grey literature to include was identified through a number of steps. First, a call was issued via the mailing list of the Poverty and Conservation Learning Group (PCLG);[4] second, a selection was made of a manageable but representative (in terms of conservation or development focus) number of international organisations that are members of the PCLG and their websites searched for relevant documents (Table 1); and third the PCLG bibliographic database was searched using the search terms: "poverty" OR "livelihoods" AND "biodiversity", OR "wildlife" OR "nature" OR "species".

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2. http://www.scopus.com/

3. http://wok.mimas.ac.uk/

4. povertyandconservation.info

Table 1: List of websites searched for grey literature

Organization	Website
A Rocha International	arocha.org
BirdLife International	birdlife.org
CARE International	careinternational.org
Caribbean Natural Resources Institute	canari.org
Catholic Agency for Overseas Development (CAFOD)	cafod.org/uk
Centre for International Forestry Research (CIFOR)	cifor.org
Convention on Biological Diversity	cbd.int
Department for International Development (DFID), UK	dfid.gov.uk
Food and Agriculture Organisation (FAO)	fao.org
International Institute for Environment and Development (IIED)	iied.org
International Union for Conservation of Nature (IUCN)	iucn.org
United Nations Environment Programme	unep.org
UNEP–World Conservation Monitoring Centre	unep-wcmc.org
United Nations Development Programme	undp.org
United States Agency for International Development (USAID)	usaid.gov
Wildlife Conservation Society (WCS)	wcs.org
World Bank	worldbank.org
Worldwide Fund for Nature International (WWF)	panda.org

Our use of disaggregated poverty and biodiversity terms in the search string was intended to ensure a comprehensive search including articles from non-traditional sources. Overall the search yielded 10,623 peer-reviewed and grey literature documents that we then screened for relevant titles (see below). However, despite the iterative development of the search terms and our broad search, the coding of papers that occurred during the data-extraction process (also described below) revealed some gaps in the search results that must be a consequence of the search terms and strings used (for example there were very few studies documenting the livelihoods impacts of the live animal trade). An obvious further limitation was that we only included material written in English potentially excluding a wealth of studies from non-Anglophone countries and organisations.

3.2 Literature screening

Having identified a large set of potentially relevant literature we then narrowed down the list through a staged screening process. We first reviewed all the article titles and rejected any that did not make any mention of biodiversity (as interpreted above) coupled with some aspect of poverty (or related terms such as livelihoods). We then screened the abstracts of that remained on our list and rejected any that did not make any mention of a link between biodiversity use/non-use and an effect on poverty/local livelihoods (so for example at this stage we rejected any that were concerned with the effect of poverty/poor people on biodiversity). We also rejected any studies that were only concerned with high income countries and any that were theoretical in nature. At this stage we also excluded any articles that had passed the abstract screening but for which we were unable to obtain downloadable copies of the full text within the time and resources available.

The title review and abstract review stages were undertaken by two researchers and a kappa test performed at each stage in order to check consistency in the interpretation of the inclusion/exclusion criteria. The kappa test result was 0.804 at the title review stage (strength of agreement between the two researchers considered to be "very good") and 0.732 at the abstract review stage (strength of agreement considered to be "good").

For the grey literature the same two researchers — with proven consistency of judgement — reviewed all the titles that our search identified as potentially relevant. However it was often difficult to judge from the titles whether the content of the articles was relevant and so consequently many more articles were retained where there was uncertainty. The majority of grey literature articles did not have abstracts and so the abstract screening stage was omitted for these articles.

The final set of articles was entered into a Microsoft Excel workbook with each article assigned a unique identifier. The workbook was structured so that each article could be analysed against a series of questions designed to tease out the link between biodiversity use/non-use and effects on poverty — as described in Figure 1. Coding was used as far as possible to answer the questions so that the results could be statistically analysed. Annex 2 provides details of the list of questions and the coding strategy.

The final stage of screening took place during this data extraction phase, which was carried out by an expanded team of five researchers. If, during the full text review and accompanying data extraction process, it became clear that studies did not meet the inclusion criteria above then they were excluded and the reason for exclusion noted. Additionally, our data extraction framework was structured to explore in more detail any studies that actually included some measure of the impact of biodiversity use/non-use on poverty. Figure 4 summarises the number of articles that were included and excluded at each stage of screening.

The majority of articles were journal papers (n = 294, 76% of the full set and n = 180, 73% of the subset with a poverty measure) followed by peer-reviewed grey literature (n = 47, 12% of full set and n = 42, 17% of subset) and non-peer reviewed published grey literature (n = 30, 8% of full set and n = 16, 2% of subset). We reviewed very few books or conference proceedings. Some articles included multiple case studies and where these were substantive case studies (n = 12) they were included as separate entries in the database.

Once all the studies had been read and data extracted, the final dataset was checked for anomalies, recoded where necessary and analysed. The full database of studies is available on the website of the Poverty and Conservation Learning Group.[5]

Figure 4. The number of articles retrieved in the initial search, and the numbers passing each subsequent stage of screening

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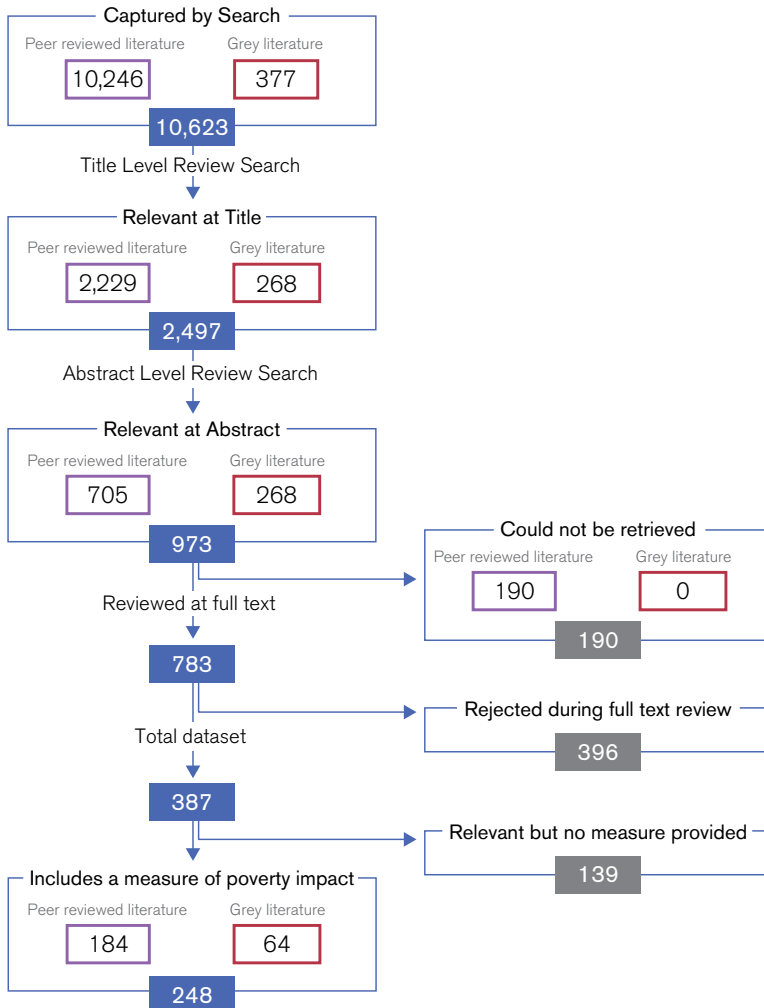
4
Results

4.1 Representativeness of evidence base

4.1.1 Geographical coverage

For the full dataset, the studies were widely distributed, covering 27 countries from Africa, 16 from Asia, 13 from Latin America and 3 from Oceania (with some studies covering more than one country). The most commonly studied region was Africa (n = 169, 43%) within which the most commonly studied country was South Africa (n = 31, 18%). The next most studied region was Asia (n = 142, 36%) within which the most studied country was India (n =45, 32%). There was a smaller proportion of studies in Latin America - potentially reflecting our English-only language bias (n = 54, 14%) and Oceania (n=3, >1%). A further 24 studies (6%) were global in coverage. Figure 5 shows the regional distribution of studies.

Figure 5: Location of studies in full dataset (NB some studies covered more than one location hence total number exceed n=387 studies)
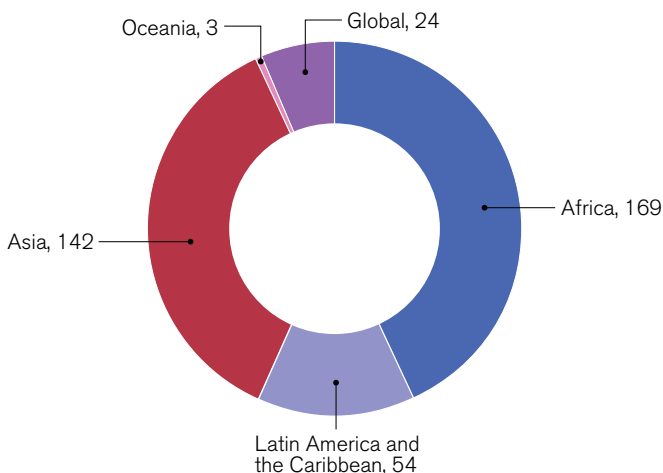
4.1.2   Ecological coverage

Our assessment of the ecological distribution of studies employed a version of the IUCN habitats classification scheme (IUCN undated) simplified by Birdlife (Fishpoolperscomm 2011). By far the most studied habitat was forests (n=202, 52% of the full set of papers, n= 125, 52% of the subset with a poverty measure). The second most studied (n=88, 23% of the full set; n = 49, 17% of the subset) was terrestrial artificial habitats (this category includes, for example, agricultural land, pasture land, gardens). Wetlands (n=40), marine (n=31), coastlines (n=29), savannah (n=29) and grasslands (n=24) were all relatively similarly studied, while the least studied habitats were artificial aquatic landscapes, mountains, deserts and introduced/exotic habitats. Figure 6 summarises the results.

Figure 6: Distribution of studies in different ecological habitats (blue columns represent total dataset meeting primary inclusion criteria (n = 387); red columns represent subset with a measure of poverty impact (n = 248)
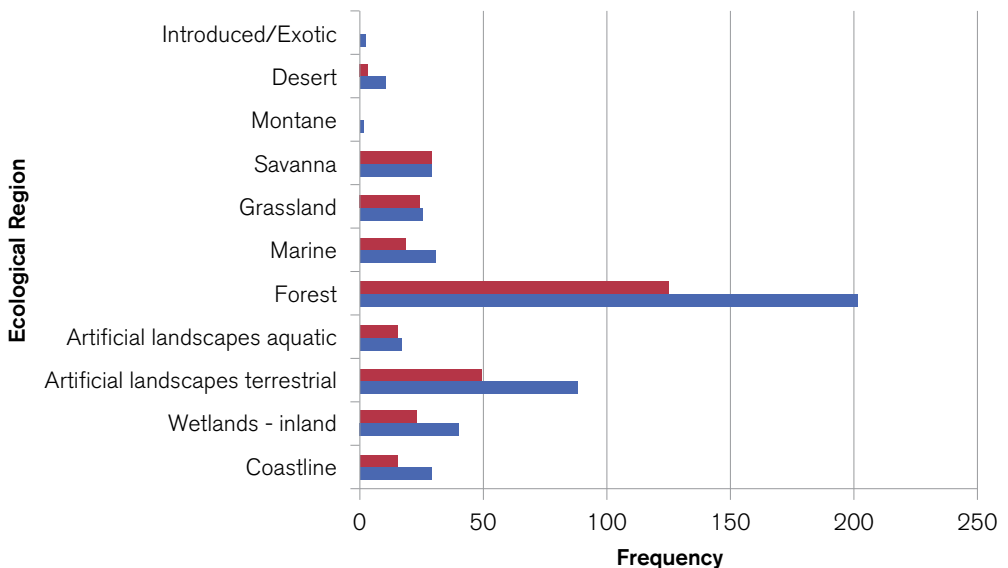
4.2 Description of evidence base

4.2.1 Dimensions and aspects of poverty studied

The Ecosystem Services for Poverty Alleviation (ESPA) programme has produced a conceptual framework for understanding poverty (Suich 2012). This identifies — from a review of the literature — 19 commonly used dimensions of poverty. Our analysis only identified studies that addressed 11 of these, plus an additional dimension — energy security. Although most studies examined more than one dimension of poverty, the most commonly studied was income (n = 270, 70% of all papers, and n= 205, 83% of papers with a poverty measure). Other commonly studied dimensions were food security (n=124, 32% of all papers) and asset accumulation (n = 91, 23% of all papers). The least commonly studied were energy, shelter and safe water. Figure 7 describes the frequency of study of each dimension.

Figure 7: Dimensions of poverty studied (blue columns represent total dataset meeting primary inclusion criteria; red columns represent subset with a measure of poverty impact)
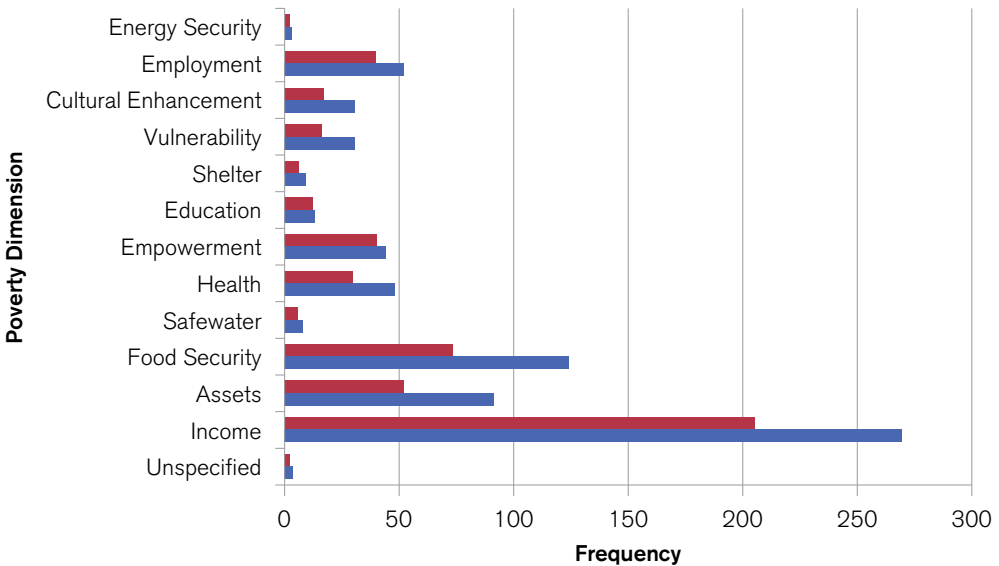
The ESPA poverty framework highlights the dynamic nature of poverty and recommends that attention should be paid to both short term (temporal) poverty as well as long term, chronic poverty. It is also important to distinguish between absolute poverty — as measured against a defined poverty line — and relative poverty. Just over half (n=196, 51%) of the papers we reviewed specified the aspect of poverty being studied. Of these 61% (n=120) were concerned with relative poverty and 39% (n=76) were concerned with absolute poverty. Fewer studies considered poverty dynamics (n=94, 24%) of which the majority (n=73, 78%) focussed on chronic poverty and only a small minority (n=21, 22%) focussed on temporal poverty.

4.2.2 Components and attributes of biodiversity studied

The studies addressed different components of biodiversity — from genetic resources to ecosystems (Figure 8). We added the category "guilds" to capture studies on, for example, the role of pollinators. We made a distinction between studies that focussed on individual species and those that focussed on groups of species (for example African plains game, or "the big five"). We also distinguished studies that were focussed on particular types of resources — rather than specific species — for example non-timber forest products (NTFPs). This resources category was the most commonly studied component of biodiversity (n=146, 38% of all papers) within which the most commonly studied type of resource was NTFPs (n= 134, 92%). The least commonly studied components were guilds (n=3, <1%) and genetic resources (n=19, 5%). The remaining studies were relatively evenly distributed between ecosystems (n=91, 23%), species (n=90, 23%) and groups of species (n=62, 16%).

Figure 8: Components of biodiversity studied (blue columns represent total dataset meeting primary inclusion criteria; red columns represent subset with a measure of poverty impact)

In most cases, the abundance or extent of biodiversity was the attribute that made it important for poverty alleviation (n=268, 70% of all papers). Diversity itself was the least frequently noted attribute (n=83, 21%) (Figure 9).

Figure 9: Attributes of biodiversity studied (blue columns represent total dataset meeting primary inclusion criteria; red columns represent subset with a measure of poverty impact)
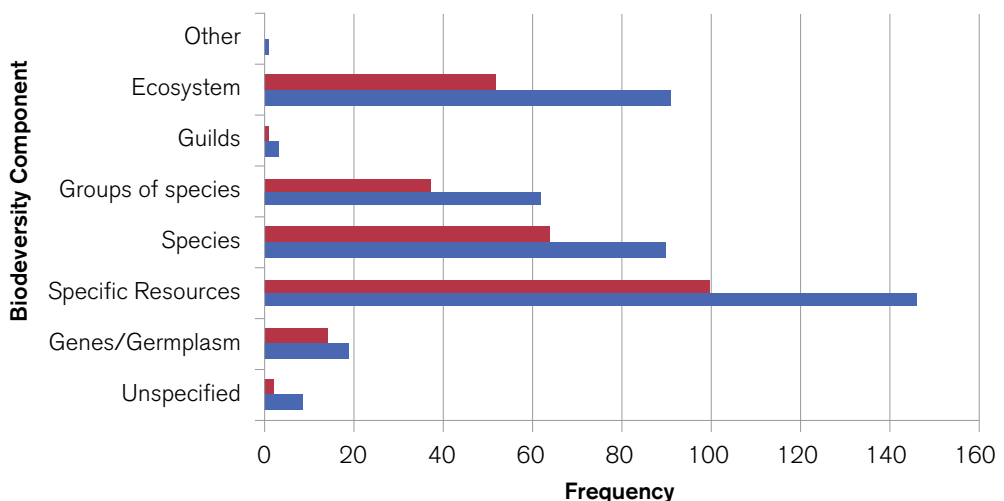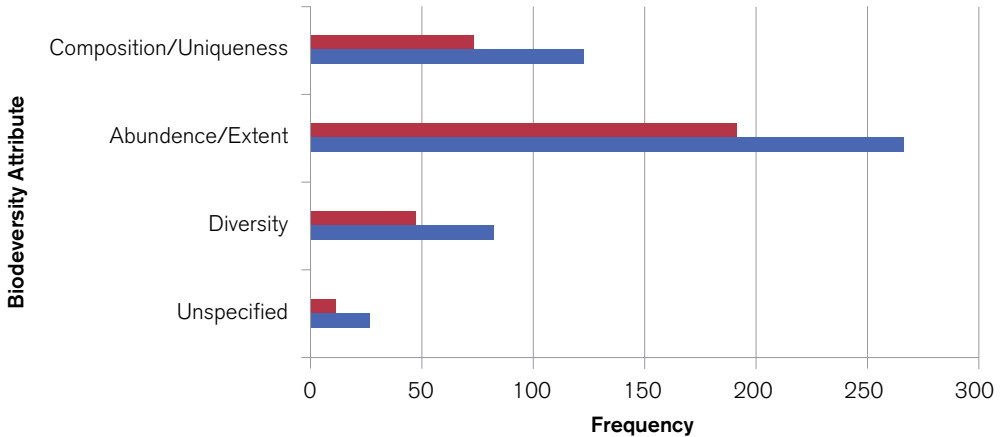

4.2.3 Nature of the relationship between biodiversity and poverty

In our analytical framework we identified a number of mechanisms by which a link can be made between biodiversity and poverty which we categorised as direct use, indirect use, non-use, and "biodiversity dis-services". For the purposes of this study we used "use" and "non-use" terminology in a slightly different way to that commonly used in the concept of total economic value (TEV). Our use of the term "direct use" is consistent with TEV and refers to the consumptive use of certain species or resources such as NTFPs for subsistence or tradable purposes. In this case species or resources are removed from nature. Indirect use refers to the benefits derived from biodiversity being left in situ rather than being removed and includes, for example use of biodiversity for tourism or for soil nutrient cycling. Non-use refers to the co-benefits such as jobs that can arise from biodiversity management efforts such as jobs. These first three categories all refer to the benefits that people get from biodiversity but we recognise that biodiversity can also impose costs. Our final category of "biodiversity dis-services" therefore refers to the negative impacts that components of biodiversity can have on people. As noted earlier, we deliberately did not set out to retrieve studies on the health impacts of parasites and diseases — if we had we would expect this category to have a much higher frequency of

papers. The majority of studies falling into this category thus largely referred to cases of human-wildlife conflict.

The most common mechanism for linking biodiversity and poverty was through direct use of different components of biodiversity (mentioned in n= 338, 87% of all papers) (Figure 10).

Figure 10: Mechanisms for linking biodiversity and poverty (blue columns represent total dataset meeting primary inclusion criteria; red columns represent subset with a measure of poverty impact)

We further investigated the mechanism by which biodiversity and poverty are linked by identifying the precise form of uses — or disservices described in the studies. Figure 11 illustrates the wide variety of mechanisms employed, with the most commonly identified being NTFP harvesting (noted in 203, 52% of studies).

Figure 11: Different mechanisms by which people experience costs and benefits of biodiversity (blue columns represent total dataset meeting primary inclusion criteria; red columns represent subset with a measure of poverty impact)
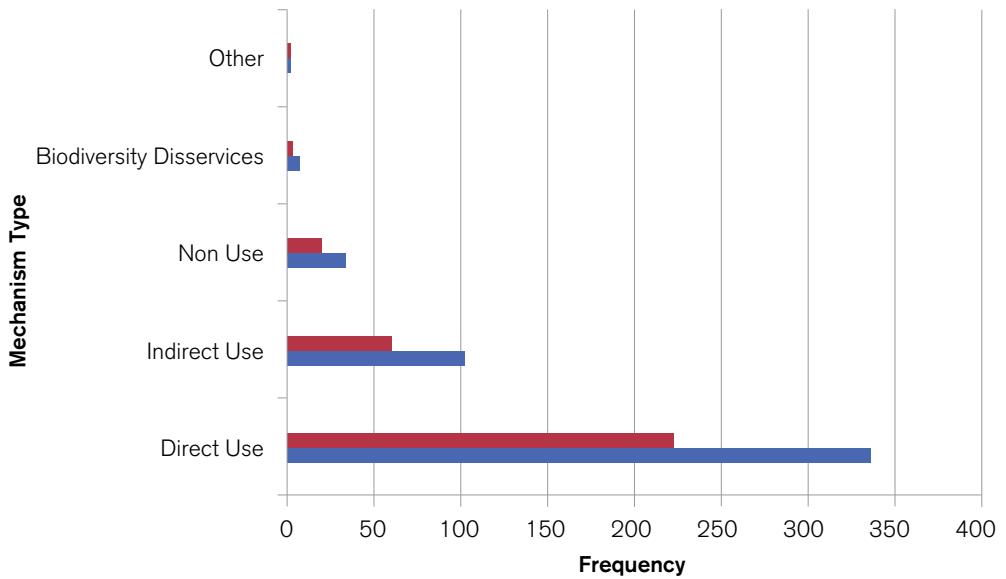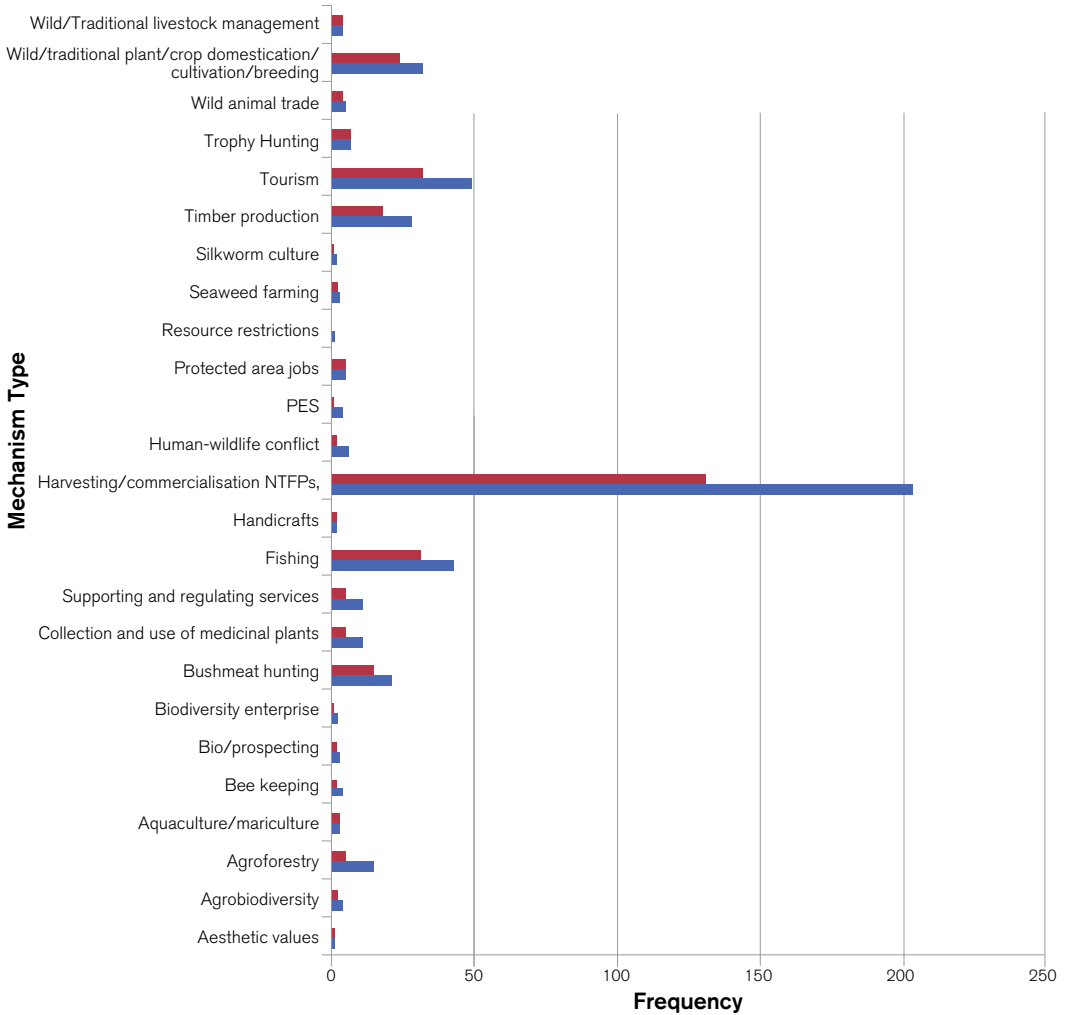
Having identified the type of mechanisms by which biodiversity was linked to poverty, we also looked at how the mechanism worked. We differentiated between use of biodiversity for subsistence purposes only or to generate a tradable surplus or income. We also differentiated between immediate use and contributions to longer term resilience — for example through maintaining productive land and ecosystems. Finally we noted any studies that described the use of biodiversity as providing an emergency lifeline or safety net and those where it had a negative effect and actually undermined livelihood security. Figure 12 shows that the most commonly identified processes by which biodiversity affects poverty are through generating income (n= 316, 82% of all papers) and supporting subsistence needs (n=271, 70% of all papers). Very few studies identified one process alone — so in many cases specific components of biodiversity were used for subsistence purposes and for trade. Less commonly identified processes were contributing to longer term resilience (n=78, 20% of all papers) and acting as a safety net (n=35, 9% of all papers).

Figure 12: Studies showing contributions (positive and negative) of biodiversity to poverty (blue columns represent total dataset meeting primary inclusion criteria; red columns represent subset with a measure of poverty impact)
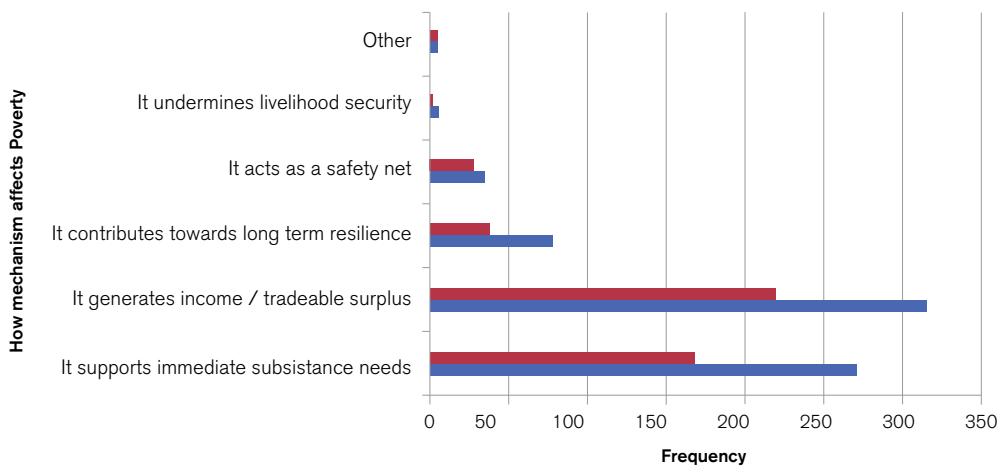
To further enhance our understanding of how biodiversity contributes to poverty we compared the different mechanisms through which biodiversity has been used with the different dimensions of poverty. Table 3 shows that, collectively, the studies of most mechanisms for linking biodiversity with poverty addressed multiple dimensions of poverty but that this was particularly pronounced in studies of fishing, NTFPs, tourism and wild plant cultivation where almost all dimensions of poverty were considered in one or more study. We have already reported that income was the most commonly studied dimension of poverty (Figure 6). Table 2 shows that it is also the most commonly mentioned dimension of poverty across all the different mechanisms. While the greatest number of papers mentioning income were NTFP studies (mentioned in n= 142 of 203 papers (71%)), the types of studies with the highest proportional mention of income were tourism (n= 40 out of 49 papers (82%)) and wild plant cultivation (n= 26 out of 32 papers (81%)).

Table 2: Frequency with which different dimensions of poverty are mentioned in studies of different mechanisms for linking biodiversity and poverty

	Unspecified	Income	Assets	Food Security	Safewater	Health	Enpowerment	Education	Shelter	Vulnerability	Cultural Enhancement	Employment	Energy Security	Other
Wild/Traditional livestock management	0	3	1	2	0	1	0	0	0	1	1	0	0	0
Wild/traditional plant/crop domestication/cultivation/breeding	0	26	5	19	1	4	3	1	0	5	5	4	1	0
Wild animal trade	0	5	0	0	0	0	0	0	0	0	0	1	0	0
Trophy Hunting	0	7	0	1	0	0	3	0	0	0	0	3	0	0
Tourism	0	40	11	6	1	3	13	2	1	3	8	14	0	0
Timber production	1	18	14	5	0	3	3	0	0	2	1	3	0	0
Silkworm culture	0	2	0	0	0	0	0	0	0	0	0	0	0	0
Seaweed farming	0	1	0	0	0	0	1	0	0	0	0	1	0	0
Resource restrictions	2	0	0	0	0	0	0	0	0	0	0	0	0	0
Protected area jobs	0	5	2	0	0	2	4	2	0	0	1	4	0	0
PES	0	3	1	0	0	0	0	0	0	0	0	0	0	0
Human-wildlife conflict	1	3	3	2	0	0	0	0	0	1	0	1	0	
Harvesting/commercialisation NTFPs	3	142	54	57	7	29	25	7	8	19	10	19	2	0
Handicrafts	0	1	0	0	0	0	0	0	0	0	1	1	0	0
Fishing	0	29	8	24	1	4	4	2	2	1	4	9	1	0
Supporting and regulating services	0	6	5	6	1	1	1	0	1	0	0	0	1	
Collection and use of medicinal plants	0	6	7	3	0	4	1	0	1	0	2	0	0	0
Bushmeat hunting	0	13	3	15	0	1	1	0	0	0	2	2	0	0
Biodiversity enterprise	0	2	0	0	0	0	1	0	0	0	1	2	0	0
Bio-prospecting	0	2	0	0	0	0	0	0	0	0	0	0	0	0
Bee keeping	0	3	1	0	0	1	0	0	0	0	0	1	0	0
Aquaculture/Mariculture	0	3	0	2	0	0	0	0	0	0	0	2	0	0
Agroforestry	1	10	2	10	0	0	0	1	0	2	0	2	0	0
Agrobiodiversity	0	1	1	2	0	0	0	0	0	0	1	0	0	0
Aesthetic values	0	0	0	0	0	1	0	0	0	0	0	0	0	0

4.2.4   Impact of biodiversity on poverty: nature and scale

The overwhelming majority of papers (n= 326, 84%) described a positive effect of biodiversity on poverty. However, only two-thirds of these actually included any measure of that effect. Measures related to almost all the dimensions of poverty were used although the most common type of measure was income-related (used in n=223 of the 248 (90%) papers that used a poverty measure). The specific measures used varied quite considerably and included: absolute amount of income generated per capita or household from use of biodiversity; household or per capita income generated from biodiversity as a proportion of total household or per capita income; and, income equivalent of biodiversity-related household consumption). Non-income measures included increases in food availability and intake; numbers of jobs created; improvements in health; improvements in asset productivity.

Over half of the studies that did measure the poverty impact included some indication of the scale of impact – ie the number of beneficiaries reached and the scale of benefits. However this was hugely variable (from less than ten to several thousand dollars per person per year) and the depended on the sample size of the study amongst other factors. Less than one-third of studies included any indication of the likely duration of impact. Of these, the majority considered the impact to be long term, 14% considered it to be short term and 9% seasonal. Just over one-third (n=85, 34%) considered the outcomes to be achievable elsewhere — beyond the study context.

4.2.5   Sustainability of biodiversity use

In the subset of studies that employed a measure of poverty impact, only just over half included any consideration of whether the use of biodiversity was sustainable. Of these use was considered sustainable in 65% of cases. When this finding was compared with the type of use of biodiversity it can be seen — not surprisingly — that most doubts about the sustainability of use were associated with direct (consumptive) use mechanisms. Biodiversity use was considered to be unsustainable in 21% of direct use studies compared to 13% for indirect use studies (Figure 13).

Figure 13: Proportion of studies of different types that considered biodiversity use to be sustainable
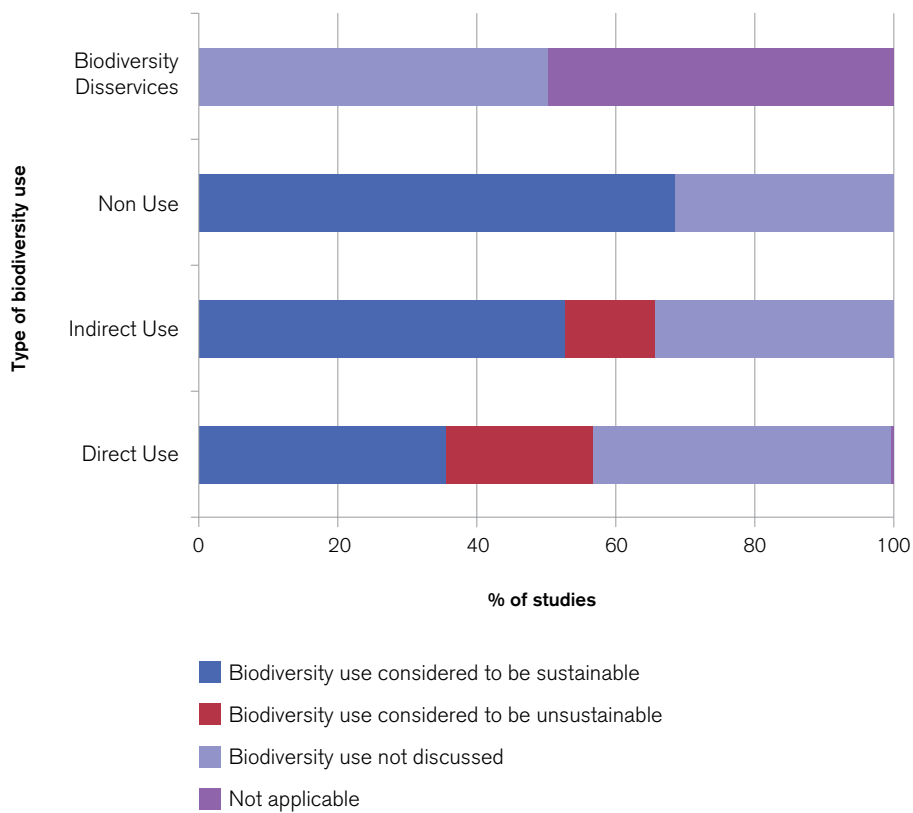
4.3 Quality of evidence

Without making any judgements as to the superiority of one research design or method over another we categorized our subset of studies with a poverty measure according to whether they were based on primary or secondary data, and whether they had adopted an experimental, quasi-experimental or non-experimental research design. It was not possible to determine the research design in all the studies — some reported impact data without providing any details on how it was obtained. However, the majority of studies (n=162, 65%) were based on primary data. Amongst these, the most common research design was non-experimental (n=151, 93%). We only identified 11 (<5%) studies that were based on experimental or quasi-experimental research.

We also looked at the extent to which studies had addressed issues which we considered would have a significant impact on the biodiversity-poverty relationship and therefore which we would expect to be raised in a 'good' study. These included the governance regime, resource rights regime, land tenure, power relations and distribution of impacts. We found that only a small proportion (21%) of the studies included any discussion of power relations and only just over one-third (36%) considered trade-offs from biodiversity use. Each of the remaining issues was addressed by roughly half of the studies in each case (Table 3).

Table 3: Frequency with which different dimensions of poverty are mentioned in studies of different mechanisms for linking biodiversity and poverty

Does the paper consider....	Yes	No	Not applicable / not mentioned
Distributional impacts	126	121	1
The governance regime	115	107	26
The resource rights regime	128	92	28
The land tenure regime	116	105	27
Power relations	53	188	7
Possible trade-offs/costs as well as benefits	90	157	1

5
Discussion

5.1 Quantity and distribution of evidence

Our systematic mapping exercise returned a good number of sources of evidence relating to our overall research question. The sources of evidence were dominated by peer-reviewed journal papers, which may be more because they are easier to find than because they truly dominate evidence on our subject matter. This is discussed further in the conclusions section below. There was a clear increase over time in the number of sources returned by our search suggesting growing interest in the topic among the research community, although it must be noted that the total number of papers in all fields has also grown rapidly over the same period (Larsen and Von Ins 2010).

The geographical distribution of sources of evidence showed a clear skew in favour of research from Africa. Given that Africa is the poorest region of the world and the subject of many combined conservation and development interventions, this is perhaps not surprising. The relatively low number of studies returned for Latin America and Asia may reflect language of publication as much as the actually existing volume of evidence. We were also interested to note that the majority (66%) of studies – irrespective of their location – were conducted by "international" (those based outside of the country of study) rather than "local" (those based in the same country as the study) researchers. This is not a surprising finding, and has been demonstrated in environmental science more generally (Karlsson *et al.* 2007).

5.2 Dimensions of poverty and components of biodiversity studied

It has been widely noted that studies relevant to links between poverty and biodiversity tend to treat poverty as a uni-dimensional issue related to income (Vira and Kontoleon 2013). Our analysis certainly confirmed the dominance of income as a measure of poverty.

However, over half the sources of evidence did measure more than one dimension of poverty, challenging the earlier characterization of the literature. A large proportion of all studies either did not mention or did not specify the aspect or dynamic of poverty they were measuring, suggesting that these issues may not have been considered important by researchers. Given the well-established importance of relative versus absolute and temporal versus chronic poverty (Hulme *et al.* 2001' Suich 2012) this is an area requiring more research, or at the very least more clarity in future publications.

The dominance of studies in forest systems is interesting, given that poor people make use of biodiversity in a wide range of different ecosystems. It seems unlikely that studies based in forests would be disproportionately likely to be identified by our search, so we suggest that the relationship between poverty and biodiversity in non-forest habitats is an area requiring further study. Drylands, for example are home to a disproportionate proportion of the world's poor whose livelihoods depend on land and livestock (Millennium Ecosystem Assessment 2005 b). The importance of biodiversity - for fodder, fibre and medicines – seems obvious but is poorly studied and documented (Davies *et al.* 2012).

Evidence was found on a wide range of components of biodiversity, with only guilds and genes/germplasm mentioned rarely. The former may be due to 'guild' being a rather specialist term, but the latter indicates a promising avenue for further research on links to poverty. It is interesting, however, to note the lack of studies that consider the importance of diversity per se. Given that by some interpretations biodiversity only refers to diversity, and not other attributes of living organisms, this is perhaps a cause for concern. In most cases the evidence is focused on particular species or the extent / abundance of a set of species with a particular link to poverty, and we do not know enough about issues such as whether such species could be replaced by others performing the same role for the poor, or the role of diversity in providing resilience.

It is perhaps not surprising that the most commonly cited component of biodiversity under study was NTFPs given the preponderance of studies based in forest habitats. This does seem to confirm once again that the evidence base is strongest in regard to the use made of forest products by the poor. An alternative interpretation is that the term NTFP is potentially all-encompassing, prompting Belcher (2003) to ask: "what isn't an NTFP?". We encountered a wide range of species that were classified as NTFPs. Further disaggregation and analysis would provide greater understanding of which particular species - or NTFP properties - appear to be particularly valuable for different groups of poor people in different ecological and governance contexts.

5.3 The nature of biodiversity-poverty linkages

The evidence base on biodiversity-poverty linkages is dominated by studies of the direct, consumptive, use of biodiversity by people. Very few studies reported negative impacts for poverty, which is partly due to our decision to exclude health impacts of pathogens. Nonetheless, it does seem that there is very little research into negative impacts of biodiversity on poverty beyond human-wildlife conflict studies. Our exercise returned remarkably few studies on issues such as live animal trade, aquaculture and agrobiodiversity. More focussed systematic maps would be useful to determine if this lack of studies is a consequence of the limitations of our search string, or indeed whether further research on these issues is needed.

Because the majority of studies that we found were focussed on the consumptive use of biodiversity by people, it is not surprising that the most common effects reported were related to meeting subsistence needs and generating a source of income. More focussed systematic maps would be useful to determine if the limited number of studies we found documenting the effect that biodiversity's role in contributing to long term resilience or acting as a safety net has on poverty reflects a lack of evidence or a limitation in our search.

We were surprised by the number of studies that included no information about the sustainability of biodiversity use given that this is of critical importance to any discussion of the relationship between biodiversity and poverty. Measuring sustainability is clearly challenging, in that it requires long term studies and a sophisticated understanding of ecological processes that produce biodiversity of value to the poor. This is an area clearly in need of further research.

5.4 Quality of evidence

The limited number of studies we found that had adopted experimental or quasi-experimental research designs is consistent with the findings of other researchers who have called for more controlled studies and counterfactual analysis (Barrett *et al.* 2011). The majority of our studies, however, describe people's everyday use of and interaction with biodiversity. They are not experiments but real world situations where controls do not exist. Thus we didn't find research design to be a good indicator of quality — although it was equally frustrating to identify case studies — particularly in the grey literature — that presented data without providing any insights into how that data was collected or validated.

We attempted to balance a focus on research design with an assessment of the extent to which key issues that have an impact of the relationship between biodiversity and poverty had been addressed in studies but again the degree to which different issues are relevant in different contexts is highly variable and thus their treatment not a comparable indicator of quality. Further debate is required as to what constitutes high or low quality evidence when attempting to evaluate complex, real-world situations rather than tightly defined and controllable interventions (Adams and Sandbrook 2013; Haddaway and Pullin 2013) — particularly if full systematic reviews are conducted in the future to explore more specific questions within the topic of the link between biodiversity and poverty.

6
Conclusions

Both biodiversity and poverty are complex, multi-dimensional concepts. Searching for relevant literature that addresses the question "Which components of biodiversity affect which dimensions of poverty" meant that we had to cast our net wide in order to capture this complexity — as our search string detailed in Annex 1 illustrates — but as a result also had to filter out a lot of irrelevant material. While we eliminated the irrelevant material we also recognised that our search has missed areas of relevant literature. This suggests that we may have chosen our initial keywords poorly, and also reinforces the point that no matter how objective and systematic the review, it is only ever as good as the keywords and reviewers.

Shortcomings in our coverage of specific the types of use people make of biodiversity (such as through wildlife trade) could be rectified in subsequent maps by further refinement and testing of our search terms. But in part the limitations of our search are influenced by the complexity of biodiversity and the difficulties in constructing a search string that accounts for that complexity. Thus we have identified no studies, for example, on the role of below-ground biodiversity in maintaining or improving soil productivity which in turn results in improved crop productivity which in turn contributes to increased income and improved food security. While we have sought to map the evidence base it is not clear the extent to which evidence exists and was not captured in our search, or simply does not exist.

Nevertheless, we generated a database of nearly 400 studies that document the effect (positive and negative) of one or more components of biodiversity on one or more dimensions of poverty and within that, a subset of 248 studies that have actually sought to measure that effect in some quantifiable way. While the studies are not directly comparable owing to the wide variety of metrics used as well as the different scale of analysis and study designs, collectively the map can shed light on the validity of claims that conserving biodiversity can reduce poverty. The implications for policy and research are discussed below.

6.1 Implications for policy and management

The map includes evidence on a wide range of different components of biodiversity - but particularly species and ecosystems - affecting different dimensions of poverty – particularly income, assets and food security. The overwhelming majority of studies indicates a positive effect of biodiversity on poverty. Caveats aside as to our coverage of biodiversity "dis-services" this implies that development planners should take far more seriously the importance of biodiversity in the lives of poor people. While much lip-service is paid to this relationship, "mainstream" development pathways continue to degrade the natural environment and deplete biodiversity as has been highlighted in numerous analyses – most recently the Millennium Ecosystem Assessment[6] and the study on The Economics of Ecosystems and Biodiversity (TEEB).[7]

This does not necessarily imply more funding and greater attention to externally-driven conservation interventions, however. This map did not seek to explore the effectiveness of conservation interventions nor their impacts on poor people. Most of the studies we identified did not relate to any particular intervention but rather to the day-to-day use that poor people make of biodiversity. This implies that maximising the benefits of biodiversity for poverty alleviation means ensuring people's continued ability to access and use it. This in turn implies attention to biodiversity governance — promoting local control through strong and enforceable resource rights. Such processes are, however, hard to measure which can be difficult to reconcile with the current trend of development policy to be more "evidence-based". Furthermore we currently have no way of knowing how much of "what works" (and is therefore considered of policy relevance) is documented and therefore available for inclusion in systematic maps such as this and able to influence policy. Attention is needed to how better to integrate the documented and undocumented, the "scientific" and traditional in order to generate a much richer evidence base. This is an issue to which the newly established Intergovernmental Panel on Biodiversity and Ecosystem Services (IPBES) is expecting to pay close attention. Its draft work programme for 2014-2018 (IPBES 2013) includes guidance on how to address and include indigenous and local knowledge within its scientific assessments as a key early deliverable.

6. maweb.org

7. teebweb.org

6.2 Implications for research

The systematic map highlighted the difficulties in comprehensively reviewing the evidence on biodiversity-poverty in one study. We have identified a number of apparent gaps in the evidence base but given the difficulties we encountered in ensuring a comprehensive search we would recommend, in the first instance, further analysis to determine which of these are real knowledge gaps that require primary research (as opposed to gaps resulting from limitations of our search strategy). It was noticeable from our map that in the majority of the literature biodiversity is framed in terms of its value as a resource — in the form of specific goods that can be used to generate tangible benefits such as cash, food and fuel. Very few studies explored the underpinning role of biodiversity in ecosystem service delivery — as it is framed in the MA —and fewer really investigated the benefits of genetic diversity in terms of increasing resilience and adaptive capacity.

Key areas that we identified for follow-up research are:

Investigation into the value role of diversity compared to abundance of resources. The majority of the studies we identified implied that the abundance or availability of particular species or resources was more critical than their diversity. Quantifying the value of diversity and where it is particularly important in delivering ecosystem services would make a significant contribution to the biodiversity-poverty debate.

More research on less tangible components of biodiversity. We found few studies that dealt with genetic diversity, microbes or even invertebrates. The studies that have been undertaken to date barely scratch the surface in terms of the full complement of biodiversity.

Biodiversity-poverty trade-offs. We were surprised that more studies did not consider the sustainability of biodiversity use. More research into key factors underlying sustainability in different contexts and for different types of use, as well as consideration of thresholds and tipping points would help decision-makers balance the drive for poverty reduction with the need for biodiversity conservation.

Long verses short term biodiversity-poverty links. The majority of the evidence we found documented the contribution of biodiversity to short term needs. More analysis is required to uncover the evidence/generate new evidence on the role of biodiversity in poverty prevention and enhancing longer term resilience.

Investigation into policies and institutions that work to enable an effective contribution of biodiversity to poverty reduction.

More detailed sector-by-sector reviews on key mechanisms for generating value from biodiversity — including wildlife trade, crop improvements, fishing etc — together with an analysis of underlying conditions influencing success or failure.

Analyses of biodiversity-poverty interactions in non-forest ecosystems, particularly those that are home to significant numbers of poor people such as drylands.

6.3 Reflections on the systematic map approach

This study used a systematic mapping approach to evaluate the state of the evidence on the relationship between biodiversity and poverty. As this is still a relatively new technique that has not been much applied in the conservation and development fields, we thought it might be useful to share some reflections on our experience of using the approach.

In general we have found the systematic approach useful, in that our study definitely captured some material that we otherwise would not have found using a traditional literature review based on existing knowledge and following references from bibliographies. The review protocol also helped us to gather the consistent information from every paper and report, rather than to pick out particularly interesting information and ignore the rest. We are sure that this approach has resulted in a good overview of the evidence-base.

On the other hand, we have found some aspects of the approach difficult. It proved difficult to generate a search string that was sufficiently comprehensive — yet manageable — and the lack of availability of sources of evidence outside of the western 'scientific' literature forced us to limit our search to academic papers and a small subset of the 'grey' literature. We were not able to review any other sources of knowledge; a limitation our work shares with the great majority of other systematic review and mapping exercises.

Our overall conclusion is that the systematic mapping approach is very useful, but that readers should be cautious in their interpretation of the results and recognise that systematic does not necessarily equate to comprehensive. We have systematically reviewed just one small corner of human knowledge on the relations between biodiversity and poverty.

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Appendices

Appendix 1: Evolution of search string

Search string	No. Hits	Changes
TITLE-ABS-KEY("Biodiversity") AND TITLE-ABS-KEY("Poverty")	Scopus = 574	
TITLE-ABS-KEY("Biodiversity" OR " Biological" OR "diversity" OR " Bio-diversity" OR " Wildlife" OR " Nature" OR " Ecosystem" OR " Ecological" OR "system" OR " Agro-biodiversity" OR " Agrobiodiversity" OR "Habitat" OR "Species" OR "Genetic diversity") AND TITLE-ABS-KEY(poverty)	Scopus = 15,048	Alternative terms for "biodiversity". "Environment excluded as too broad
TITLE-ABS-KEY("Biodiversity" OR " Biological" OR "diversity" OR " Bio-diversity" OR " Wildlife" OR " Nature" OR " Ecosystem" OR " Ecological" OR "system" OR " Agro-biodiversity" OR " Agrobiodiversity" OR " Habitat" OR " Species" OR " Genetic" OR "diversity" OR " Mammal" OR " Bird" OR " Plant" OR " Reptile" OR " Amphibian" OR " Insect" OR " tree" OR " animal" OR " fish" OR " fungus" OR " mushroom" OR " fruit" OR " vegetable" OR " Bushmeat" OR " Fish" OR " Ntfp" OR " Non-timber" OR "forest" OR "product" OR " Nontimber" OR "forest" OR "product" OR " Crop" OR " Foodcrop" OR " Natural" OR "resource" OR " Medicinal" OR "plant" OR " Livestock" OR " Forest" OR " Dryland" OR " Ocean" OR " Savannah" OR " Mountain" OR " Mangrove" OR " Coastal" OR " Grassland" OR " Marine") AND TITLE-ABS-KEY("POVERTY")	Scopus = 24,016	Added biodiversity components especially for resources
TITLE-ABS-KEY("Protected area" OR "Sustainable use" OR "Conservation" OR "Park" OR "Biodiversity" OR " Biological" OR "diversity" OR " Bio-diversity" OR " Wildlife" OR " Nature" OR " Ecosystem" OR " Ecological" OR "system" OR " Agro-biodiversity" OR " Agrobiodiversity" OR " Habitat" OR " Species" OR " Genetic" OR "diversity" OR " Mammal" OR " Bird" OR " Plant" OR " Reptile" OR " Amphibian" OR " Insect" OR " tree" OR " animal" OR " fish" OR " fungus" OR " mushroom" OR " fruit" OR " vegetable" OR " Bushmeat" OR " Fish" OR " Ntfp" OR " Non-timber" OR "forest" OR "product" OR " Nontimber" OR "forest" OR "product" OR " Crop" OR " Foodcrop" OR " Natural" OR "resource" OR " Medicinal" OR "plant" OR " Livestock" OR " Forest" OR " Dryland" OR " Ocean" OR " Savannah" OR " Mountain" OR " Mangrove" OR " Coastal" OR " Grassland" OR " Marine") AND TITLE-ABS-KEY("POVERTY")	Scopus = 24,159	Added common terms related to biodiversity ("Protected area" OR "Sustainable use" OR "Conservation" OR "Park")

Search string	No. Hits	Changes
TITLE-ABS-KEY("Protected area*" OR"Sustainable use*" OR"Conservation*" OR"Park*" OR"Biodiversity*" OR" Biological*" OR"diversity*" OR" Bio-diversity*" OR" Wildlife*" OR" Nature*" OR" Ecosystem*" OR" Ecological*" OR"system*" OR" Agro-biodiversity*" OR" Agrobiodiversity*" OR" Habitat*" OR" Species*" OR" Genetic*" OR"diversity*" OR" Mammal*" OR" Bird*" OR" Plant*" OR" Reptile*" OR" Amphibian*" OR" Insect*" OR" tree*" OR" animal*" OR" fish*" OR" fungus*" OR" mushroom*" OR" fruit*" OR" vegetable*" OR" Bushmeat*" OR" Fish*" OR" Ntfp*" OR" Non-timber*" OR"forest*" OR"product*" OR" Nontimber*" OR"forest*" OR"product*" OR" Crop*" OR" Foodcrop*" OR" Natural*" OR"resource*" OR" Medicinal*" OR"plant*" OR" Livestock*" OR" Forest*" OR" Dryland*" OR" Ocean*" OR" Savannah*" OR" Mountain*" OR" Mangrove*" OR" Coastal*" OR" Grassland*" OR" Marine*") AND TITLE-ABS-KEY("POVERTY*")	Scopus = 27,089	Added wildcard for every search term
TITLE-ABS-KEY("Protected area" OR "Sustainable" OR "Conserv*" OR "Park" OR "Biodiversity" OR " Biological diversity" OR " Bio-diversity" OR " Wildlife" OR " Nature" OR " Ecosystem" OR " Ecological system" OR " Agro-biodiversity" OR " Agrobiodiversity" OR " Habitat" OR " Species" OR " Genetic diversity" OR " Mammal" OR " Bird" OR " Plant" OR " Reptile" OR " Amphibian" OR " Insect" OR " tree" OR " animal" OR " fish" OR " fungus*" OR " mushroom" OR " fruit" OR " vegetable" OR " Bushmeat" OR " Fish" OR " Ntfp" OR " Non-timber forest product" OR " Nontimber forest product" OR " Crop*" OR " Foodcrop" OR " Natural resource" OR " Medicinal plant" OR " Livestock" OR " Forest*" OR " Dryland" OR " Ocean" OR " Savannah" OR " Mountain" OR " Mangrove" OR " Coastal" OR " Grassland" OR " Marine") AND TITLE-ABS-KEY("Poverty" OR "Poor people" OR "Livelihood*" OR "Wellbeing" OR "Well-being")	Scopus = 26,601	Added poverty terms ("Poverty*" OR "Poor people*" OR "Livelihood*" OR "Wellbeing*" OR "Well-being*"); refined use of wildcards
TITLE-ABS-KEY("Protected area" OR "Conserv*" OR "Park" OR "Biodiversity" OR " Biological diversity" OR " Bio-diversity" OR " Wildlife" OR " Nature" OR " Ecosystem" OR " Ecological system" OR " Agro-biodiversity" OR " Agrobiodiversity" OR " Habitat" OR " Species" OR " Genetic diversity" OR " Mammal" OR " Bird" OR " Plant" OR " Reptile" OR " Amphibian" OR " Insect" OR " tree" OR " animal" OR " fish" OR " fungus*" OR " mushroom" OR " fruit" OR " vegetable" OR " Bushmeat" OR " Fish" OR " Ntfp" OR " Non-timber forest product" OR " Nontimber forest product" OR " Crop*" OR " Foodcrop" OR " Natural resource" OR " Medicinal plant" OR " Livestock" OR " Forest*" OR " Dryland" OR " Ocean" OR " Savannah" OR " Mountain" OR " Mangrove" OR " Coastal" OR " Grassland" OR " Marine") AND TITLE-ABS-KEY("Poverty" OR "Poor people" OR "Livelihood*" OR "Wellbeing" OR "Well-being")	Scopus = 23,859	Excluded "sustainable" to get rid of environmental management literature

Search string	No. Hits	Changes
TITLE-ABS-KEY("Protected area" OR "Conserv*" OR "Park" OR "Biodiversity" OR "Biological diversity" OR "Bio-diversity" OR "Wildlife" OR "Nature" OR "Ecosystem" OR "Ecological system" OR "Agro-biodiversity" OR "Agrobiodiversity" OR "Habitat" OR "Species" OR "Genetic diversity" OR "Mammal" OR "Bird" OR "Plant" OR "Reptile" OR "Amphibian" OR "Insect" OR "tree" OR "animal" OR "fish" OR "fungus*" OR "mushroom" OR "fruit" OR "vegetable" OR "Bushmeat" OR "Fish" OR "Ntfp" OR "Non-timber forest product" OR "Nontimber forest product" OR "Crop*" OR "Foodcrop" OR "Natural resource" OR "Medicinal plant" OR "Livestock" OR "Forest*" OR "Dryland" OR "Ocean" OR "Savannah" OR "Mountain" OR "Mangrove" OR "Coastal" OR "Grassland" OR "Marine") AND TITLE-ABS-KEY("Poverty" OR "Poor people" OR "Livelihood*" OR "Wellbeing" OR "Well-being") AND TITLE-ABS-KEY("People" OR "Social" OR "Village" OR "Household" OR "Farmer" OR "Hunter" OR "Fisher*" OR "Dweller" OR "Indigenous")	Scopus = 13,237	Qualifier that it had to have human element – new tier of terms added
TITLE-ABS-KEY("Protected area" OR "Conserv*" OR "Park" OR "Biodiversity" OR "Biological diversity" OR "Bio-diversity" OR "Wildlife" OR "Nature" OR "Ecosystem" OR "Ecological system" OR "Agro-biodiversity" OR "Agrobiodiversity" OR "Habitat" OR "Species" OR "Genetic diversity" OR "Mammal" OR "Bird" OR "Plant" OR "Reptile" OR "Amphibian" OR "Insect" OR "tree" OR "animal" OR "fish" OR "fungus*" OR "mushroom" OR "fruit" OR "vegetable" OR "Bushmeat" OR "Fish" OR "Ntfp" OR "Non-timber forest product" OR "Nontimber forest product" OR "Crop*" OR "Foodcrop" OR "Natural resource" OR "Medicinal plant" OR "Livestock" OR "Forest*" OR "Dryland" OR "Ocean" OR "Savannah" OR "Mountain" OR "Mangrove" OR "Coastal" OR "Grassland" OR "Marine") AND TITLE-ABS-KEY("Poverty" OR "Poor people" OR "Livelihood*" OR "Wellbeing" OR "Well-being") AND TITLE-ABS-KEY("Income" OR "Health" OR "Security" OR "Asset" OR "Educat*" OR "Employ" OR "Job" OR "Sanitation" OR "Empower" OR "Mortality" OR "Hous*" OR "Life expect" OR "Insur*" OR "Risk") AND TITLE-ABS-KEY("People" OR "Social" OR "Village" OR "Household" OR "Farmer" OR "Hunter" OR "Fisher*" OR "Dweller" OR "Indigenous") AND (LIMIT-TO(SUBJAREA, "AGRI") OR LIMIT-TO(SUBJAREA, "ENVI") OR LIMIT-TO(SUBJAREA, "SOCI") OR LIMIT-TO(SUBJAREA, "EART") OR LIMIT-TO(SUBJAREA, "AGRI") OR LIMIT-TO(SUBJAREA, "ENVI") OR LIMIT-TO(SUBJAREA, "SOCI") OR LIMIT-TO(SUBJAREA, "EART") OR LIMIT-TO(SUBJAREA, "ECON") OR LIMIT-TO(SUBJAREA, "MULT") OR LIMIT-TO(SUBJAREA, "MULT"))	Scopus = 6,040	Added dimensions of poverty and limited to relevant subject areas.

Search string	No. Hits	Changes
TITLE-ABS-KEY("Protected area" OR "Conserv*" OR "Park" OR "Biodiversity" OR "Biological diversity" OR "Bio-diversity" OR "Wildlife" OR "Nature" OR "Ecosystem" OR "Ecological system" OR "Agro-biodiversity" OR "Agrobiodiversity" OR "Habitat" OR "Species" OR "Genetic diversity" OR "Mammal" OR "Bird" OR "Plant" OR "Reptile" OR "Amphibian" OR "Insect" OR "tree" OR "animal" OR "fish" OR "fungus*" OR "mushroom" OR "fruit" OR "vegetable" OR "Bushmeat" OR "Fish" OR "Ntfp" OR "Non-timber forest product" OR "Nontimber forest product" OR "Crop*" OR "Foodcrop" OR "Natural resource" OR "Medicinal plant" OR "Livestock" OR "Forest*" OR "Dryland" OR "Ocean" OR "Savannah" OR "Mountain" OR "Mangrove" OR "Coastal" OR "Grassland" OR "Marine") AND TITLE-ABS-KEY("Poverty" OR "Poor people" OR "Livelihood*" OR "Wellbeing" OR "Well-being") AND TITLE-ABS-KEY("poverty" OR "Income" OR "Health" OR "Security" OR "Asset" OR "Educat*" OR "Employ" OR "Job" OR "Sanitation" OR "Empower" OR "Mortality" OR "Hous*" OR "Life expect" OR "Insur*" OR "Risk") AND TITLE-ABS-KEY("People" OR "Social" OR "Village" OR "Household" OR "Farmer" OR "Hunter" OR "Fisher*" OR "Dweller" OR "Indigenous") AND (LIMIT-TO(SUBJAREA, "AGRI") OR LIMIT-TO(SUBJAREA, "ENVI") OR LIMIT-TO(SUBJAREA, "SOCI") OR LIMIT-TO(SUBJAREA, "EART") OR LIMIT-TO(SUBJAREA, "AGRI") OR LIMIT-TO(SUBJAREA, "ENVI") OR LIMIT-TO(SUBJAREA, "SOCI") OR LIMIT-TO(SUBJAREA, "EART") OR LIMIT-TO(SUBJAREA, "ECON") OR LIMIT-TO(SUBJAREA, "MULT") OR LIMIT-TO(SUBJAREA, "MULT"))	Scopus = 7,263	Added "poverty" option to disaggregated poverty dimensions in order to still capture articles that discussed poverty in a more general sense

Search string	No. Hits	Changes
TITLE-ABS-KEY("Protected area" OR "Conserv*" OR "Park" OR "Biodiversity" OR "Biological diversity" OR "Bio-diversity" OR "Wildlife" OR "Nature" OR "Ecosystem" OR "Ecological system" OR "Agro-biodiversity" OR "Agrobiodiversity" OR "Habitat" OR "Species" OR "Genetic diversity" OR "Mammal" OR "Bird" OR "Plant" OR "Reptile" OR "Amphibian" OR "Insect" OR "tree" OR "animal" OR "fish" OR "fungus*" OR "mushroom" OR "fruit" OR "vegetable" OR "Bushmeat" OR "Fish" OR "Ntfp" OR "Non-timber forest product" OR "Nontimber forest product" OR "Crop*" OR "Foodcrop" OR "Natural resource" OR "Medicinal plant" OR "Livestock" OR "Forest*" OR "Dryland" OR "Ocean" OR "Savannah" OR "Mountain" OR "Mangrove" OR "Coastal" OR "Grassland" OR "Marine") AND TITLE-ABS-KEY("Poverty" OR "Poor people" OR "Livelihood*" OR "Wellbeing" OR "Well-being") AND TITLE-ABS-KEY("poverty" OR "Income" OR "Health" OR "Security" OR "Asset" OR "Educat*" OR "Employ" OR "Job" OR "Sanitation" OR "Empower" OR "Mortality" OR "Hous*" OR "Life expect" OR "Insur*" OR "Risk") AND TITLE-ABS-KEY("People" OR "Social" OR "Village" OR "Household" OR "Farmer" OR "Hunter" OR "Fisher*" OR "Dweller" OR "Indigenous") AND (LIMIT-TO(SUBJAREA, "SOCI") OR LIMIT-TO(SUBJAREA, "ENVI") OR LIMIT-TO(SUBJAREA, "AGRI") OR LIMIT-TO(SUBJAREA, "EART") OR LIMIT-TO(SUBJAREA, "ECON") OR LIMIT-TO(SUBJAREA, "MULT")) AND (EXCLUDE(SUBJAREA, "MEDI") OR EXCLUDE(SUBJAREA, "VETE") OR EXCLUDE(SUBJAREA, "PSYC") OR EXCLUDE(SUBJAREA, "ENGI") OR EXCLUDE(SUBJAREA, "BIOC")) AND (EXCLUDE(SUBJAREA, "ARTS") OR EXCLUDE(SUBJAREA, "BUSI") OR EXCLUDE(SUBJAREA, "ENER") OR EXCLUDE(SUBJAREA, "NURS")) AND (EXCLUDE(SUBJAREA, "COMP") OR EXCLUDE(SUBJAREA, "IMMU") OR EXCLUDE(SUBJAREA, "CENG") OR EXCLUDE(SUBJAREA, "CHEM")) AND (EXCLUDE(SUBJAREA, "DECI") OR EXCLUDE(SUBJAREA, "PHAR") OR EXCLUDE(SUBJAREA, "MATH") OR EXCLUDE(SUBJAREA, "MATE")) AND (EXCLUDE(SUBJAREA, "HEAL") OR EXCLUDE(SUBJAREA, "PHYS") OR EXCLUDE(SUBJAREA, "DENT"))	Scopus = 5,485	Excluded more subject areas (as those intended to be excluded were not being so)

Search string	No. Hits	Changes
TITLE-ABS-KEY("Protected area" OR "Conserv*" OR "Park" OR "Biodiversity" OR "Biological diversity" OR "Bio-diversity" OR "Wildlife" OR "nature" OR "Ecosystem" OR "Ecological system" OR "Agro-biodiversity" OR "Agrobiodiversity" OR "Habitat" OR "Species" OR "Genetic diversity" OR "Mammal" OR "Bird" OR "Plant" OR "Reptile" OR "Amphibian" OR "Insect" OR "tree" OR "animal" OR "fish" OR "fungus*" OR "mushroom" OR "fruit" OR "vegetable" OR "Bushmeat" OR "Fish" OR "Ntfp" OR "Non-timber forest product" OR "Nontimber forest product" OR "Crop*" OR "Foodcrop" OR "CBNRM" OR "Medicinal plant" OR "Livestock" OR "Forest*" OR "Dryland" OR "Ocean" OR "Savannah" OR "Mountain" OR "Mangrove" OR "Coastal" OR "Grassland" OR "Marine") AND TITLE-ABS-KEY("Poverty" OR "Poor people" OR "Livelihood*" OR "Wellbeing" OR "Well-being") AND TITLE-ABS-KEY("poverty" OR "Income" OR "Health" OR "Security" OR "Asset" OR "Educat*" OR "Employ" OR "Job" OR "Sanitation" OR "Empower" OR "Mortality" OR "Hous*" OR "Life expect" OR "Insur*" OR "Risk") AND TITLE-ABS-KEY("People" OR "Social" OR "Village" OR "Household" OR "Farmer" OR "Hunter" OR "Fisher*" OR "Dweller" OR "Indigenous") AND (LIMIT-TO(SUBJAREA, "SOCI") OR LIMIT-TO(SUBJAREA, "ENVI") OR LIMIT-TO(SUBJAREA, "AGRI") OR LIMIT-TO(SUBJAREA, "EART") OR LIMIT-TO(SUBJAREA, "ECON") OR LIMIT-TO(SUBJAREA, "MULT")) AND (EXCLUDE(SUBJAREA, "MEDI") OR EXCLUDE(SUBJAREA, "VETE") OR EXCLUDE(SUBJAREA, "PSYC") OR EXCLUDE(SUBJAREA, "ENGI") OR EXCLUDE(SUBJAREA, "BIOC")) AND (EXCLUDE(SUBJAREA, "ARTS") OR EXCLUDE(SUBJAREA, "BUSI") OR EXCLUDE(SUBJAREA, "ENER") OR EXCLUDE(SUBJAREA, "NURS")) AND (EXCLUDE(SUBJAREA, "COMP") OR EXCLUDE(SUBJAREA, "IMMU") OR EXCLUDE(SUBJAREA, "CENG") OR EXCLUDE(SUBJAREA, "CHEM")) AND (EXCLUDE(SUBJAREA, "DECI") OR EXCLUDE(SUBJAREA, "PHAR") OR EXCLUDE(SUBJAREA, "MATH") OR EXCLUDE(SUBJAREA, "MATE")) AND (EXCLUDE(SUBJAREA, "HEAL") OR EXCLUDE(SUBJAREA, "PHYS") OR EXCLUDE(SUBJAREA, "DENT"))	Scopus = 5,249	Natural resources = problematic, replaced with CBNRM. List presented to experts workshop, August 2012

Search string	No. Hits	Changes
TITLE-ABS-KEY("Protected area" OR "Conserv*" OR "Park" OR "Biodiversity" OR "Biological diversity" OR "Bio-diversity" OR "Wildlife" OR "Nature" OR "Ecosystem" OR "Ecological system" OR "Agro-biodiversity" OR "Agrobiodiversity" OR "Habitat" OR "Species" OR "Genetic diversity" OR "Mammal" OR "Bird" OR "Plant" OR "Reptile" OR "Amphibian" OR "Insect" OR "tree" OR "animal" OR "fish" OR "fungus*" OR "mushroom" OR "fruit" OR "vegetable" OR "Bushmeat" OR "Fish" OR "Ntfp" OR "Non-timber forest product" OR "Nontimber forest product" OR "Crop*" OR "Foodcrop" OR "Natural resource" OR "Medicinal plant" OR "Livestock" OR "Forest*" OR "Dryland" OR "Ocean" OR "Savanna*"OR "Mountain" OR "Mangrove" OR "Coastal" OR "Grassland" OR "Marine") AND TITLE-ABS-KEY("Poverty" OR "Poor people" OR "Livelihood*" OR "Wellbeing" OR "Well-being") AND TITLE-ABS-KEY("poverty" OR "Income" OR "Health" OR "Security" OR "Asset" OR "Educat*" OR "Employ" OR "Job" OR "Sanitation" OR "Empower" OR "Mortality" OR "Hous*" OR "Life expect" OR "Insur*" OR "Risk") AND TITLE-ABS-KEY("People" OR "Social" OR "Village" OR "Household" OR "Farmer" OR "Hunter" OR "Fisher*" OR "Dweller" OR "Indigenous") AND (LIMIT-TO(SUBJAREA, "SOCI") OR LIMIT-TO(SUBJAREA, "ENVI") OR LIMIT-TO(SUBJAREA, "AGRI") OR LIMIT-TO(SUBJAREA, "EART") OR LIMIT-TO(SUBJAREA, "ECON") OR LIMIT-TO(SUBJAREA, "SOCI") OR LIMIT-TO(SUBJAREA, "ENVI") OR LIMIT-TO(SUBJAREA, "AGRI") OR LIMIT-TO(SUBJAREA, "EART") OR LIMIT-TO(SUBJAREA, "ECON") OR LIMIT-TO(SUBJAREA, "SOCI") OR LIMIT-TO(SUBJAREA, "ENVI") OR LIMIT-TO(SUBJAREA, "AGRI") OR LIMIT-TO(SUBJAREA, "EART") OR LIMIT-TO(SUBJAREA, "ECON") OR LIMIT-TO(SUBJAREA, "MULT")) AND (EXCLUDE(SUBJAREA, "MEDI") OR EXCLUDE(SUBJAREA, "VETE") OR EXCLUDE(SUBJAREA, "PSYC") OR EXCLUDE(SUBJAREA, "ENGI") OR EXCLUDE(SUBJAREA, "BIOC")) AND (EXCLUDE(SUBJAREA, "ARTS") OR EXCLUDE(SUBJAREA, "BUSI") OR EXCLUDE(SUBJAREA, "ENER") OR EXCLUDE(SUBJAREA, "NURS")) AND (EXCLUDE(SUBJAREA, "COMP") OR EXCLUDE(SUBJAREA, "IMMU") OR EXCLUDE(SUBJAREA, "CENG") OR EXCLUDE(SUBJAREA, "CHEM")) AND (EXCLUDE(SUBJAREA, "DECI") OR EXCLUDE(SUBJAREA, "PHAR") OR EXCLUDE(SUBJAREA, "MATH") OR EXCLUDE(SUBJAREA, "MATE")) AND (EXCLUDE(SUBJAREA, "HEAL") OR EXCLUDE(SUBJAREA, "PHYS") OR EXCLUDE(SUBJAREA, "DENT"))	Scopus 5,518	As at workshop but with Savanna*

Search string	No. Hits	Changes
TITLE-ABS-KEY("Protected area" OR "Conserv*"OR "Park" OR "Biodiversity" OR "Biological diversity" OR "Bio-diversity" OR "Wildlife" OR "Nature" OR "Ecosystem" OR "Ecological system" OR "Agro-biodiversity" OR "Agrobiodiversity" OR "Habitat" OR "Species" OR "Genetic diversity" OR "Mammal" OR "Bird" OR "Plant" OR "Reptile" OR "Amphibian" OR "Insect" OR "tree" OR "animal" OR "fish" OR "fungus*" OR "mushroom" OR "fruit" OR "vegetable" OR "Bushmeat" OR "Fish" OR "Ntfp" OR "Non-timber forest product" OR "Nontimber forest product" OR "Crop*" OR "Foodcrop" OR "Natural resource" OR "Medicinal plant" OR "Livestock" OR "Forest*" OR "Dryland" OR "Ocean" OR "Savanna*"OR "Mountain" OR "Mangrove" OR "Coastal" OR "Grassland" OR "Marine") AND TITLE-ABS-KEY("Poverty" OR "Poor people" OR "Livelihood*" OR "Wellbeing" OR "Well-being") AND TITLE-ABS-KEY("poverty" OR "Income" OR "Health" OR "Security" OR "Asset" OR "Educat*" OR "Employ" OR "Job" OR "Sanitation" OR "Empower" OR "Mortality" OR "Hous*" OR "Life expect" OR "Insur*" OR "Risk" OR "Marginalis*" OR "Disadvantage*" OR "Self-esteem" OR "Sustain*" OR "Vulnerab*" OR "Hunger" OR "Nutrition*" OR "Starv*" OR "Coping" OR "Wealth*" OR "Gender") AND TITLE-ABS-KEY("People" OR "Social" OR "Village" OR "Household" OR "Farmer" OR "Hunter" OR "Fisher*" OR "Dweller" OR "Indigenous") AND (LIMIT-TO(SUBJAREA, "SOCI") OR LIMIT-TO(SUBJAREA, "ENVI") OR LIMIT-TO(SUBJAREA, "AGRI") OR LIMIT-TO(SUBJAREA, "EART") OR LIMIT-TO(SUBJAREA, "ECON") OR LIMIT-TO(SUBJAREA, "SOCI") OR LIMIT-TO(SUBJAREA, "ENVI") OR LIMIT-TO(SUBJAREA, "AGRI") OR LIMIT-TO(SUBJAREA, "EART") OR LIMIT-TO(SUBJAREA, "ECON") OR LIMIT-TO(SUBJAREA, "SOCI") OR LIMIT-TO(SUBJAREA, "ENVI") OR LIMIT-TO(SUBJAREA, "AGRI") OR LIMIT-TO(SUBJAREA, "EART") OR LIMIT-TO(SUBJAREA, "ECON") OR LIMIT-TO(SUBJAREA, "MULT")) AND (EXCLUDE(SUBJAREA, "MEDI") OR EXCLUDE(SUBJAREA, "VETE") OR EXCLUDE(SUBJAREA, "PSYC") OR EXCLUDE(SUBJAREA, "ENGI") OR EXCLUDE(SUBJAREA, "BIOC")) AND (EXCLUDE(SUBJAREA, "ARTS") OR EXCLUDE(SUBJAREA, "BUSI") OR EXCLUDE(SUBJAREA, "ENER") OR EXCLUDE(SUBJAREA, "NURS")) AND (EXCLUDE(SUBJAREA, "COMP") OR EXCLUDE(SUBJAREA, "IMMU") OR EXCLUDE(SUBJAREA, "CENG") OR EXCLUDE(SUBJAREA, "CHEM")) AND (EXCLUDE(SUBJAREA, "DECI") OR EXCLUDE(SUBJAREA, "PHAR") OR EXCLUDE(SUBJAREA, "MATH") OR EXCLUDE(SUBJAREA, "MATE")) AND (EXCLUDE(SUBJAREA, "HEAL") OR EXCLUDE(SUBJAREA, "PHYS") OR EXCLUDE(SUBJAREA, "DENT"))	Scopus = 6,320	Added additional terms to poverty tier

Search string	No. Hits	Changes
TITLE-ABS-KEY("Protected area" OR "Conserv*" OR "Park" OR "Biodiversity" OR "Biological diversity" OR "Bio-diversity" OR "Wildlife" OR "Nature" OR "Ecosystem" OR "Ecological system" OR "Agro-biodiversity" OR "Agrobiodiversity" OR "Habitat" OR "Species" OR "Genetic diversity" OR "Mammal" OR "Bird" OR "Plant" OR "Reptile" OR "Amphibian" OR "Insect" OR "tree" OR "animal" OR "fish" OR "fungus*" OR "mushroom" OR "fruit" OR "vegetable" OR "Bushmeat" OR "Fish" OR "Ntfp" OR "Non-timber forest product" OR "Nontimber forest product" OR "Crop*" OR "Foodcrop" OR "Natural resource" OR "Medicinal plant" OR "Livestock" OR "Forest*" OR "Dryland" OR "Ocean" OR "Savanna*"OR "Mountain" OR "Mangrove" OR "Coastal" OR "Grassland" OR "Marine") AND TITLE-ABS-KEY("Poverty" OR "Poor people" OR "Livelihood*" OR "Wellbeing" OR "Well-being") AND TITLE-ABS-KEY("poverty" OR "Income" OR "Health" OR "Security" OR "Asset" OR "Educat*" OR "Employ" OR "Job" OR "Sanitation" OR "Empower" OR "Mortality" OR "Hous*" OR "Life expect" OR "Insur*" OR "Risk" OR "Marginalis*" OR "Disadvantage*" OR "Self-esteem" OR "Sustain*" OR "Vulnerab*" OR "Hunger" OR "Nutrition*" OR "Starv*" OR "Coping" OR "Wealth*" OR "Gender") AND TITLE-ABS-KEY("People" OR "Social" OR "Village" OR "Household" OR "Farmer" OR "Hunter" OR "Fisher*" OR "Dweller" OR "Indigenous" OR "Pastoralis*" OR "Herder" OR "Nomad") AND (LIMIT-TO(SUBJAREA, "SOCI") OR LIMIT-TO(SUBJAREA, "ENVI") OR LIMIT-TO(SUBJAREA, "AGRI") OR LIMIT-TO(SUBJAREA, "EART") OR LIMIT-TO(SUBJAREA, "ECON") OR LIMIT-TO(SUBJAREA, "SOCI") OR LIMIT-TO(SUBJAREA, "ENVI") OR LIMIT-TO(SUBJAREA, "AGRI") OR LIMIT-TO(SUBJAREA, "EART") OR LIMIT-TO(SUBJAREA, "ECON") OR LIMIT-TO(SUBJAREA, "SOCI") OR LIMIT-TO(SUBJAREA, "ENVI") OR LIMIT-TO(SUBJAREA, "AGRI") OR LIMIT-TO(SUBJAREA, "EART") OR LIMIT-TO(SUBJAREA, "ECON") OR LIMIT-TO(SUBJAREA, "MULT")) AND (EXCLUDE(SUBJAREA, "MEDI") OR EXCLUDE(SUBJAREA, "VETE") OR EXCLUDE(SUBJAREA, "PSYC") OR EXCLUDE(SUBJAREA, "ENGI") OR EXCLUDE(SUBJAREA, "BIOC")) AND (EXCLUDE(SUBJAREA, "ARTS") OR EXCLUDE(SUBJAREA, "BUSI") OR EXCLUDE(SUBJAREA, "ENER") OR EXCLUDE(SUBJAREA, "NURS")) AND (EXCLUDE(SUBJAREA, "COMP") OR EXCLUDE(SUBJAREA, "IMMU") OR EXCLUDE(SUBJAREA, "CENG") OR EXCLUDE(SUBJAREA, "CHEM")) AND (EXCLUDE(SUBJAREA, "DECI") OR EXCLUDE(SUBJAREA, "PHAR") OR EXCLUDE(SUBJAREA, "MATH") OR EXCLUDE(SUBJAREA, "MATE")) AND (EXCLUDE(SUBJAREA, "HEAL") OR EXCLUDE(SUBJAREA, "PHYS") OR EXCLUDE(SUBJAREA, "DENT"))	Scopus = 6364	Added additional categories to the human tier ("Pastoralis*" OR "Herder" OR "Nomad")

Search string	No. Hits	Changes
TITLE-ABS-KEY("Protected area" OR "Conserv*" OR "Park" OR "*Biodiversity" OR "Biological diversity" OR "Bio-diversity" OR "Wildlife" OR "Nature" OR "Ecosystem" OR "Ecological system" OR "Habitat" OR "Species" OR "Genetic diversity" OR "Mammal" OR "Bird" OR "Plant" OR "Reptile" OR "Tiger*" OR "Elephant*" OR "Great ape" OR "Great-ape" OR "Great apes" OR "Great-apes" OR "gorilla*" OR "chimpanzee*" OR "Duiker*" OR "Lion*" OR "Primate*" OR "Amphibian" OR "Insect" OR "tree" OR "animal" OR "fungus*" OR "mushroom" OR "fruit" OR "vegetable" OR "Bushmeat" OR "Fish" OR "Ntfp" OR "Non-timber forest product" OR "Nontimber forest product" OR "Crop*" OR "Foodcrop" OR "Natural resource" OR "Medicinal plant" OR "Livestock" OR "Forest*" OR "Dryland" OR "Ocean" OR "Savanna*"OR "Mountain" OR "Mangrove" OR "Coastal" OR "Grassland" OR "Marine") AND TITLE-ABS-KEY("Poverty" OR "Poor people" OR "Livelihood*" OR "Wellbeing" OR "Well-being") AND TITLE-ABS-KEY("poverty" OR "Income" OR "Health" OR "Security" OR "Asset" OR "Educat*" OR "Employ" OR "Job" OR "Sanitation" OR "Empower" OR "Mortality" OR "Hous*" OR "Life expect" OR "Insur*" OR "Risk" OR "Marginalis*" OR "Disadvantage*" OR "Self-esteem" OR "Sustain*" OR "Vulnerab*" OR "Hunger" OR "Nutrition*" OR "Starv*" OR "Coping" OR "Wealth*" OR "Gender" OR "Safety net" OR "Safety-net") AND TITLE-ABS-KEY("People" OR "Social" OR "Village" OR "Household" OR "Farmer" OR "Hunter" OR "Fisher*" OR "Dweller" OR "Indigenous" OR "Pastoralis*" OR "Herder" OR "Nomad") AND (LIMIT-TO(SUBJAREA, "SOCI") OR LIMIT-TO(SUBJAREA, "ENVI") OR LIMIT-TO(SUBJAREA, "AGRI") OR LIMIT-TO(SUBJAREA, "EART") OR LIMIT-TO(SUBJAREA, "ECON") OR LIMIT-TO(SUBJAREA, "SOCI") OR LIMIT-TO(SUBJAREA, "ENVI") OR LIMIT-TO(SUBJAREA, "AGRI") OR LIMIT-TO(SUBJAREA, "EART") OR LIMIT-TO(SUBJAREA, "ECON") OR LIMIT-TO(SUBJAREA, "SOCI") OR LIMIT-TO(SUBJAREA, "ENVI") OR LIMIT-TO(SUBJAREA, "AGRI") OR LIMIT-TO(SUBJAREA, "EART") OR LIMIT-TO(SUBJAREA, "ECON") OR LIMIT-TO(SUBJAREA, "MULT")) AND (EXCLUDE(SUBJAREA, "MEDI") OR EXCLUDE(SUBJAREA, "VETE") OR EXCLUDE(SUBJAREA, "PSYC") OR EXCLUDE(SUBJAREA, "ENGI") OR EXCLUDE(SUBJAREA, "BIOC")) AND (EXCLUDE(SUBJAREA, "ARTS") OR EXCLUDE(SUBJAREA, "BUSI") OR EXCLUDE(SUBJAREA, "ENER") OR EXCLUDE(SUBJAREA, "NURS")) AND (EXCLUDE(SUBJAREA, "COMP") OR EXCLUDE(SUBJAREA, "IMMU") OR EXCLUDE(SUBJAREA, "CENG") OR EXCLUDE(SUBJAREA, "CHEM")) AND (EXCLUDE(SUBJAREA, "DECI") OR EXCLUDE(SUBJAREA, "PHAR") OR EXCLUDE(SUBJAREA, "MATH") OR EXCLUDE(SUBJAREA, "MATE")) AND (EXCLUDE(SUBJAREA, "HEAL") OR EXCLUDE(SUBJAREA, "PHYS") OR EXCLUDE(SUBJAREA, "DENT"))	Scopus = 6,385	Added "Tiger*" OR "Elephant*" OR "Great ape" OR "Great-ape" OR "Great apes" OR "Great-apes" OR "gorilla*" OR "chimpanzee*" OR "Duiker*" OR "Lion*" OR "Primate*" to biodiversity terms. Added 21 papers. This is considered few enough to justify not using an exhaustive list of species.

Search string	No. Hits	Changes
TITLE-ABS-KEY("Protected area" OR "Conserv*" OR "Park" OR "*Biodiversity" OR "Biological diversity" OR "Bio-diversity" OR "Wildlife" OR "Nature" OR "Ecosystem" OR "Ecological system" OR "Habitat" OR "Species" OR "Genetic diversity" OR "Mammal" OR "Bird" OR "Plant" OR "Reptile" OR "Tiger*" OR "Elephant*" OR "Great ape" OR "Great-ape" OR "Great apes" OR "Great-apes" OR "gorilla*" OR "chimpanzee*" OR "Duiker*" OR "Lion*" OR "Primate*" OR "Amphibian" OR "Insect" OR "tree" OR "animal" OR "fungus*" OR "mushroom" OR "fruit" OR "vegetable" OR "Bushmeat" OR "Fish" OR "Ntfp" OR "Non-timber forest product" OR "Nontimber forest product" OR "Crop*" OR "Foodcrop" OR "Natural resource" OR "Medicinal plant" OR "*Livestock" OR "Cattle" OR "Goat*" OR "Sheep" OR "Chicken*" OR "Poultry" OR "Forest*" OR "Dryland" OR "Ocean" OR "Savanna*"OR "Mountain" OR "Mangrove" OR "Coastal" OR "Grassland" OR "Marine") AND TITLE-ABS-KEY("Poverty" OR "Poor people" OR "Livelihood*" OR "Wellbeing" OR "Well-being") AND TITLE-ABS-KEY("poverty" OR "Income" OR "Health" OR "Security" OR "Asset" OR "Educat*" OR "Employ" OR "Job" OR "Sanitation" OR "Empower" OR "Mortality" OR "Hous*" OR "Life expect" OR "Insur*" OR "Risk" OR "Marginalis*" OR "Disadvantage*" OR "Self-esteem" OR "Sustain*" OR "Vulnerab*" OR "Hunger" OR "Nutrition*" OR "Starv*" OR "Coping" OR "Wealth*" OR "Gender" OR "Safety net" OR "Safety-net") AND TITLE-ABS-KEY("People" OR "Social" OR "Village" OR "Household" OR "Farmer" OR "Hunter" OR "Fisher*" OR "Dweller" OR "Indigenous" OR "Pastoralis*" OR "Herder" OR "Nomad") AND (LIMIT-TO(SUBJAREA, "SOCI") OR LIMIT-TO(SUBJAREA, "ENVI") OR LIMIT-TO(SUBJAREA, "AGRI") OR LIMIT-TO(SUBJAREA, "EART") OR LIMIT-TO(SUBJAREA, "ECON") OR LIMIT-TO(SUBJAREA, "SOCI") OR LIMIT-TO(SUBJAREA, "ENVI") OR LIMIT-TO(SUBJAREA, "AGRI") OR LIMIT-TO(SUBJAREA, "EART") OR LIMIT-TO(SUBJAREA, "ECON") OR LIMIT-TO(SUBJAREA, "SOCI") OR LIMIT-TO(SUBJAREA, "ENVI") OR LIMIT-TO(SUBJAREA, "AGRI") OR LIMIT-TO(SUBJAREA, "EART") OR LIMIT-TO(SUBJAREA, "ECON") OR LIMIT-TO(SUBJAREA, "MULT")) AND (EXCLUDE(SUBJAREA, "MEDI") OR EXCLUDE(SUBJAREA, "VETE") OR EXCLUDE(SUBJAREA, "PSYC") OR EXCLUDE(SUBJAREA, "ENGI") OR EXCLUDE(SUBJAREA, "BIOC")) AND (EXCLUDE(SUBJAREA, "ARTS") OR EXCLUDE(SUBJAREA, "BUSI") OR EXCLUDE(SUBJAREA, "ENER") OR EXCLUDE(SUBJAREA, "NURS")) AND (EXCLUDE(SUBJAREA, "COMP") OR EXCLUDE(SUBJAREA, "IMMU") OR EXCLUDE(SUBJAREA, "CENG") OR EXCLUDE(SUBJAREA, "CHEM")) AND (EXCLUDE(SUBJAREA, "DECI") OR EXCLUDE(SUBJAREA, "PHAR") OR EXCLUDE(SUBJAREA, "MATH") OR EXCLUDE(SUBJAREA, "MATE")) AND (EXCLUDE(SUBJAREA, "HEAL") OR EXCLUDE(SUBJAREA, "PHYS") OR EXCLUDE(SUBJAREA, "DENT"))	Scopus 6,431	Added "*Livestock" OR "Cattle" OR "Goat*" OR "Sheep" OR "Chicken*" OR "Poultry" to biodiversity terms.

Search string	No. Hits	Changes
TITLE-ABS-KEY("Protected area" OR "Conserv*" OR "Park" OR "*Biodiversity" OR "Biological diversity" OR "Bio-diversity" OR "Wildlife" OR "Nature" OR "Ecosystem" OR "Ecological system" OR "Habitat" OR "Species" OR "Genetic diversity" OR "Mammal" OR "Bird" OR "Plant" OR "Reptile" OR "Tiger*" OR "Elephant*" OR "Great ape" OR "Great-ape" OR "Great apes" OR "Great-apes" OR "gorilla*" OR "chimpanzee*" OR "Duiker*" OR "Lion*" OR "Primate*" OR "Amphibian" OR "Insect" OR "tree" OR "animal" OR "fungus*" OR "mushroom" OR "fruit" OR "vegetable" OR "Bushmeat" OR "Fish" OR "Ntfp" OR "Non-timber forest product" OR "Nontimber forest product" OR "Crop*" OR "Foodcrop" OR "Natural resource" OR "Medicinal plant" OR "*Livestock" OR "Cattle" OR "Goat*" OR "Sheep" OR "Chicken*" OR "Poultry" OR "Forest*" OR "Dryland" OR "Ocean" OR "Savanna*"OR "Mountain" OR "Mangrove" OR "Coastal" OR "Grassland" OR "Marine" OR "Freshwater" OR "Taiga" OR "Shrubland*" OR "Woodland*" OR "Tundra" OR "Desert") AND TITLE-ABS-KEY("Poverty" OR "Poor people" OR "Livelihood*" OR "Wellbeing" OR "Well-being") AND TITLE-ABS-KEY("poverty" OR "Income" OR "Health" OR "Security" OR "Asset" OR "Educat*" OR "Employ" OR "Job" OR "Sanitation" OR "Empower" OR "Mortality" OR "Hous*" OR "Life expect" OR "Insur*" OR "Risk" OR "Marginalis*" OR "Disadvantage*" OR "Self-esteem" OR "Sustain*" OR "Vulnerab*" OR "Hunger" OR "Nutrition*" OR "Starv*" OR "Coping" OR "Wealth*" OR "Gender" OR "Safety net" OR "Safety-net") AND TITLE-ABS-KEY("People" OR "Social" OR "Village" OR "Household" OR "Farmer" OR "Hunter" OR "Fisher*" OR "Dweller" OR "Indigenous" OR "Pastoralis*" OR "Herder" OR "Nomad") AND (LIMIT-TO(SUBJAREA, "SOCI") OR LIMIT-TO(SUBJAREA, "ENVI") OR LIMIT-TO(SUBJAREA, "AGRI") OR LIMIT-TO(SUBJAREA, "EART") OR LIMIT-TO(SUBJAREA, "ECON") OR LIMIT-TO(SUBJAREA, "SOCI") OR LIMIT-TO(SUBJAREA, "ENVI") OR LIMIT-TO(SUBJAREA, "AGRI") OR LIMIT-TO(SUBJAREA, "EART") OR LIMIT-TO(SUBJAREA, "ECON") OR LIMIT-TO(SUBJAREA, "SOCI") OR LIMIT-TO(SUBJAREA, "ENVI") OR LIMIT-TO(SUBJAREA, "AGRI") OR LIMIT-TO(SUBJAREA, "EART") OR LIMIT-TO(SUBJAREA, "ECON") OR LIMIT-TO(SUBJAREA, "MULT")) AND (EXCLUDE(SUBJAREA, "MEDI") OR EXCLUDE(SUBJAREA, "VETE") OR EXCLUDE(SUBJAREA, "PSYC") OR EXCLUDE(SUBJAREA, "ENGI") OR EXCLUDE(SUBJAREA, "BIOC")) AND (EXCLUDE(SUBJAREA, "ARTS") OR EXCLUDE(SUBJAREA, "BUSI") OR EXCLUDE(SUBJAREA, "ENER") OR EXCLUDE(SUBJAREA, "NURS")) AND (EXCLUDE(SUBJAREA, "COMP") OR EXCLUDE(SUBJAREA, "IMMU") OR EXCLUDE(SUBJAREA, "CENG") OR EXCLUDE(SUBJAREA, "CHEM")) AND (EXCLUDE(SUBJAREA, "DECI") OR EXCLUDE(SUBJAREA, "PHAR") OR EXCLUDE(SUBJAREA, "MATH") OR EXCLUDE(SUBJAREA, "MATE")) AND (EXCLUDE(SUBJAREA, "HEAL") OR EXCLUDE(SUBJAREA, "PHYS") OR EXCLUDE(SUBJAREA, "DENT"))	Scopus 6,466	Added "Freshwater" OR "Taiga" OR "Shrubland*" OR "Woodland*" OR "Tundra" OR "Desert" to biomes (this makes search terms consistent with WWF biome classification).

Search string	No. Hits	Changes
TITLE-ABS-KEY("Protected area" OR "Conserv*" OR "Park" OR "*Biodiversity" OR "Biological diversity" OR "Bio-diversity" OR "Wildlife" OR "Nature" OR "Ecosystem" OR "Ecological system" OR "Habitat" OR "Species" OR "Genetic diversity" OR "Mammal" OR "Bird" OR "Plant" OR "Reptile" OR "Tiger*" OR "Elephant*" OR "Great ape" OR "Great-ape" OR "Great apes" OR "Great-apes" OR "gorilla*" OR "chimpanzee*" OR "Duiker*" OR "Lion*" OR "Primate*" OR "Amphibian" OR "Insect" OR "tree" OR "animal" OR "fungus*" OR "mushroom" OR "fruit" OR "vegetable" OR "Bushmeat" OR "Fish" OR "Ntfp" OR "Non-timber forest product" OR "Nontimber forest product" OR "Crop*" OR "Foodcrop" OR "Natural resource" OR "Medicinal plant" OR "*Livestock" OR "Cattle" OR "Goat*" OR "Sheep" OR "Chicken*" OR "Poultry" OR "Timber" OR "Charcoal" OR "Fuelwood" OR "Firewood" OR "Wood" OR "Forest*" OR "Dryland" OR "Ocean" OR "Savanna*"OR "Mountain" OR "Mangrove" OR "Coastal" OR "Grassland" OR "Marine" OR "Freshwater" OR "Taiga" OR "Shrubland*" OR "Woodland*" OR "Tundra" OR "Desert") AND TITLE-ABS-KEY("Poverty" OR "Poor people" OR "Livelihood*" OR "Wellbeing" OR "Well-being") AND TITLE-ABS-KEY("poverty" OR "Income" OR "Health" OR "Security" OR "Asset" OR "Educat*" OR "Employ" OR "Job" OR "Sanitation" OR "Empower" OR "Mortality" OR "Hous*" OR "Life expect" OR "Insur*" OR "Risk" OR "Marginalis*" OR "Disadvantage*" OR "Self-esteem" OR "Sustain*" OR "Vulnerab*" OR "Hunger" OR "Nutrition*" OR "Starv*" OR "Coping" OR "Wealth*" OR "Gender" OR "Safety net" OR "Safety-net") AND TITLE-ABS-KEY("People" OR "Social" OR "Village" OR "Household" OR "Farmer" OR "Hunter" OR "Fisher*" OR "Dweller" OR "Indigenous" OR "Pastoralis*" OR "Herder" OR "Nomad") AND (LIMIT-TO(SUBJAREA, "SOCI") OR LIMIT-TO(SUBJAREA, "ENVI") OR LIMIT-TO(SUBJAREA, "AGRI") OR LIMIT-TO(SUBJAREA, "EART") OR LIMIT-TO(SUBJAREA, "ECON") OR LIMIT-TO(SUBJAREA, "SOCI") OR LIMIT-TO(SUBJAREA, "ENVI") OR LIMIT-TO(SUBJAREA, "AGRI") OR LIMIT-TO(SUBJAREA, "EART") OR LIMIT-TO(SUBJAREA, "ECON") OR LIMIT-TO(SUBJAREA, "SOCI") OR LIMIT-TO(SUBJAREA, "ENVI") OR LIMIT-TO(SUBJAREA, "AGRI") OR LIMIT-TO(SUBJAREA, "EART") OR LIMIT-TO(SUBJAREA, "ECON") OR LIMIT-TO(SUBJAREA, "MULT")) AND (EXCLUDE(SUBJAREA, "MEDI") OR EXCLUDE(SUBJAREA, "VETE") OR EXCLUDE(SUBJAREA, "PSYC") OR EXCLUDE(SUBJAREA, "ENGI") OR EXCLUDE(SUBJAREA, "BIOC")) AND (EXCLUDE(SUBJAREA, "ARTS") OR EXCLUDE(SUBJAREA, "BUSI") OR EXCLUDE(SUBJAREA, "ENER") OR EXCLUDE(SUBJAREA, "NURS")) AND (EXCLUDE(SUBJAREA, "COMP") OR EXCLUDE(SUBJAREA, "IMMU") OR EXCLUDE(SUBJAREA, "CENG") OR EXCLUDE(SUBJAREA, "CHEM")) AND (EXCLUDE(SUBJAREA, "DECI") OR EXCLUDE(SUBJAREA, "PHAR") OR EXCLUDE(SUBJAREA, "MATH") OR EXCLUDE(SUBJAREA, "MATE")) AND (EXCLUDE(SUBJAREA, "HEAL") OR EXCLUDE(SUBJAREA, "PHYS") OR EXCLUDE(SUBJAREA, "DENT"))	Scopus 6,499	Added "Timber" OR "Charcoal" OR "Fuelwood" OR "Firewood" OR "Wood" to biodiversity terms. Added 33 papers

Search string	No. Hits	Changes
TITLE-ABS-KEY("Protected area" OR "Protected areas" OR "Conserv*" OR "Park" OR "*Biodiversity" OR "Biological diversity" OR "Bio-diversity" OR "Wildlife" OR "Nature" OR "Ecosystem*" OR "Ecological system" OR "Habitat*" OR "Species" OR "Genetic diversity" OR "Mammal*" OR "Bird*" OR "Plant*" OR "Reptile*" OR "Tiger*" OR "Elephant*" OR "Great ape" OR "Great-ape" OR "Great apes" OR "Great-apes" OR "gorilla*" OR "chimpanzee*" OR "Duiker*" OR "Lion*" OR "Primate*" OR "Amphibian*" OR "Insect*" OR "tree*" OR "animal*" OR "fungus*" OR "fungi" OR "mushroom*" OR "fruit*" OR "vegetable*" OR "Bushmeat" OR "Fish" OR "Ntfp" OR "Non-timber forest product" OR "Nontimber forest product" OR "Nontimber forest products" OR "Non-timber forest products" OR "Crop*" OR "Foodcrop*" OR "Natural resource" OR "Natural Resources" OR "Medicinal plant" OR "Medicinal plants" OR "*Livestock" OR "Cattle" OR "Goat*" OR "Sheep" OR "Chicken*" OR "Poultry" OR "Timber" OR "Charcoal" OR "Fuelwood" OR "Firewood" OR "Wood" OR "Forest*" OR "Dryland*" OR "Ocean*" OR "Savanna*"OR "Mountain*" OR "Mangrove*" OR "Coastal" OR "Grassland*" OR "Marine" OR "Freshwater" OR "Taiga" OR "Shrubland*" OR "Woodland*" OR "Tundra" OR "Desert*") AND TITLE-ABS-KEY("Poverty" OR "Poor people" OR "Livelihood*" OR "Wellbeing" OR "Well-being") AND TITLE-ABS-KEY("poverty" OR "Income" OR "Health" OR "Security" OR "Asset*" OR "Educat*" OR "Employ*" OR "Job" OR "Jobs" OR "Unemploy*" OR "Sanitation" OR "Empower*" OR "Mortality" OR "Hous*" OR "Life expect*" OR "Insur*" OR "Risk*" OR "Marginalis*" OR "Disadvantage*" OR "Self-esteem" OR "Sustain*" OR "Vulnerab*" OR "Hunger" OR "Nutrition*" OR "Starv*" OR "Coping" OR "Wealth*" OR "Gender" OR "Safety net" OR "Safety-net" OR "People" OR "Social" OR "Village*" OR "Household*" OR "Farmer*" OR "Hunter*" OR "Fisher*" OR "Dweller*" OR "Indigenous" OR "Pastoralis*" OR "Herder*" OR "Nomad*") AND (LIMIT-TO(SUBJAREA, "SOCI") OR LIMIT-TO(SUBJAREA, "ENVI") OR LIMIT-TO(SUBJAREA, "AGRI") OR LIMIT-TO(SUBJAREA, "EART") OR LIMIT-TO(SUBJAREA, "ECON") OR LIMIT-TO(SUBJAREA, "SOCI") OR LIMIT-TO(SUBJAREA, "ENVI") OR LIMIT-TO(SUBJAREA, "AGRI") OR LIMIT-TO(SUBJAREA, "EART") OR LIMIT-TO(SUBJAREA, "ECON") OR LIMIT-TO(SUBJAREA, "SOCI") OR LIMIT-TO(SUBJAREA, "ENVI") OR LIMIT-TO(SUBJAREA, "AGRI") OR LIMIT-TO(SUBJAREA, "EART") OR LIMIT-TO(SUBJAREA, "ECON") OR LIMIT-TO(SUBJAREA, "MULT")) AND (EXCLUDE(SUBJAREA, "MEDI") OR EXCLUDE(SUBJAREA, "VETE") OR EXCLUDE(SUBJAREA, "PSYC") OR EXCLUDE(SUBJAREA, "ENGI") OR EXCLUDE(SUBJAREA, "BIOC")) AND (EXCLUDE(SUBJAREA, "ARTS") OR EXCLUDE(SUBJAREA, "BUSI") OR EXCLUDE(SUBJAREA, "ENER") OR EXCLUDE(SUBJAREA, "NURS")) AND (EXCLUDE(SUBJAREA, "COMP") OR EXCLUDE(SUBJAREA, "IMMU") OR EXCLUDE(SUBJAREA, "CENG") OR EXCLUDE(SUBJAREA, "CHEM")) AND (EXCLUDE(SUBJAREA, "DECI") OR EXCLUDE(SUBJAREA, "PHAR") OR EXCLUDE(SUBJAREA, "MATH") OR EXCLUDE(SUBJAREA, "MATE")) AND (EXCLUDE(SUBJAREA, "HEAL") OR EXCLUDE(SUBJAREA, "PHYS") OR EXCLUDE(SUBJAREA, "DENT"))	Scopus = 10,623	Removed the AND term between poverty dimensions and types of poor people. Added more wildcards to capture plurals

Appendix 2: Data extraction questions and codes

A1 - What is the source of evidence?

Book/Book chapter	12
Conference proceedings	13
Peer-review published journal paper	14
Peer-reviewed published grey literature	15
Published grey literature	16
Unpublished grey literature	17
Other	97

A2 - What is the dimension of poverty being discussed?

Unspecified	98
Income	12
Assets	13
Food Security	14
Safe water	15
Health	16
Empowerment	17
Education	18
Shelter	19
Vulnerability	20
Cultural Enhancement	21
Employment	22
Energy Security	23
Other	97

A3 - What is the aspect of poverty being addressed?

Unspecified	98
Absolute	12
Relative	13
Chronic	14
Temporal	15
Not mentioned	16
Other	97

A4 - What component of biodiversity is discussed as affecting poverty?

Unspecified	98
Genes/Germplasm	12
Specific Resources	13
Species	14
Groups of species	15
Not mentioned	16
Guilds	17
Other	97

A5 - What attribute of biodiversity is discussed as affecting poverty?

Unspecified	98
Diversity	12
Abundance/Extent	13
Composition/Uniqueness	14
Other	97

A6 - Does the evidence relate to a specific intervention? Referring to external interventions/projects eg The PSE scheme as opposed to ongoing day to day use

Yes	11
No	10

A6a - Is the intervention intended to be a conservation intervention, development intervention or one that links the two?

Option 1	12
Option 2	13
Option 3	14

A7 - What is the mechanism by which biodiversity affects poverty?

Direct Use	12
Indirect Use	13
Non Use	14
Human wildlife conflict	15
Other	97

A7 - What is the mechanism by which biodiversity affects poverty?

No coding free text

A8 - How does the mechanism affect poverty?

It supports immediate subsistence needs	12
It generates income/tradable surplus	13
It contributes to long term resilience	14
It acts as a safety net	15
It undermines livelihood security	16
Other	97

A8a - Describe precisely how.

No coding free text

A9 - Does the evidence assess the direction of the impact of biodiversity on poverty?

No	10
Yes positive	12
Yes negative	13
Yes neutral	14
Yes mixed	15

A10 - Where is the approach/ research undertaken?

No coding free text

A11 - In which habitat/ecosystem is the approach undertaken/research, applied to?

Coastline	12
Wetlands – inland	13
Artificial landscapes terrestrial	14
Artificial landscapes aquaculture	15
Forest	16
Marine	17
Grassland	18
Savannah	19
Montane	20
Desert	21
Introduced/Exotic	22
Other	97

A12 - Does the evidence provide a measure of the poverty impact?

Yes	11
No	10

B1 - What is the location of the primary authors/institution?

No coding free text

B2 - Is the evidence site specific?

Yes	11
No	10

B3 - What is the research type?

Primary and experimental	12
Secondary	13
Theoretical/Conceptual	14
Not applicable	99

B4 - What research design was utilised?

Experimental research	12
Quasi experimental research	13
Non-experimental research	14
Systematic review	15
Non-systematic review	16
Theoretical/Conceptual	17

B5 - What research methods were used?

Quantitative	92
Qualitative	13

B6 - What was the unit of analysis and sample size?

Individual	98
Household	12
Village/Locality	13
Region/District	14
Country	15
Study	16
Plots	17
Other	97

C1 - Does the evidence mention the general biodiversity status of the country/region?

Yes	11
No	10

C2 - Does the evidence describe the biodiversity status of the site?

Yes	11
No	10
Not applicable	99

C3 - Does the evidence mention the general poverty status of the country/region?

Yes	11
No	10

C4 - Does the evidence describe the poverty/socioeconomic status of the site?

Yes	11
No	10
Not applicable	99

C5 - Does the evidence discuss the governance regime at the site?

Yes	11
No	10

C5a - What is the governance regime?

Option 1	12
Option 2	13
Option 3	14
Option 4	15
Other	97

C6 - Does the evidence discuss the resource rights regime?

Yes	11
No	10
Not applicable	99

C7 - Does the evidence discuss the land tenure regime?

Yes	11
No	10
Not applicable	99

C8 - Does the evidence mention power relations?

Yes mentioned	30
Yes effects analysed	31
No	10
Not applicable	99

C9 - Does the evidence consider possible trade-offs/costs as well as benefits?

Yes mentioned	30
Yes effects analysed	31
No	10
Not applicable	99

D1 - What measures of poverty impact has been used?

No coding free text	98

D2 - Does the evidence assess the scale of impact?

Yes	11
No	10

D3 - Does the evidence consider distribution impacts?

Yes mentioned	30
Yes different groups identified	12
Yes detail on specifics provided	31
No	10
Not applicable	99

D4 - Does the evidence consider the duration of impact?

Yes	11
No	10
Unclear	12

D5 - Does the evidence consider whether the outcome is replicable elsewhere?

Yes	11
No	10

D6 - Does the evidence include consideration of the thresholds/boundary limits/ tipping points of achieving the outcome?

Yes Mentioned	30
Yes specifics identified	31
No	10
Not applicable	99

D7 - Is there consideration of how costs and benefits/impacts might vary across different spatial scales?

Yes Mentioned	30
Yes specifics identified	31
No	10

D8 - Does the evidence consider if the use of biodiversity is sustainable?

Yes Considered to be sustainable	12
Yes Considered to be unsustainable	13
Not discussed	14
Not applicable	99

D9 - Does the evidence acknowledge the presence of possible confounding factors?

Yes acknowledged and taken into account in study design	98
Yes acknowledged but not taken into account/not clear if taken into account in study design	12
No not mentioned	13

International policy statements refer to the apparently self-evident truth that preserving biodiversity is closely linked to alleviating poverty. Certainly, development planners should take biodiversity more seriously — mainstream development pathways continue to degrade natural environments and deplete valuable biodiversity resources. But a systematic mapping of the literature shows that rigorous, documented evidence of whether, how, and how far biodiversity can alleviate poverty is surprisingly sparse. This research report presents the rationale behind this systematic mapping exercise, its methodology and results, and concludes that researchers and policymakers must do more to explore the complex relationships that exist if policies and institutions that enable an effective contribution of biodiversity to poverty reduction are to be maximised.

IIED is a policy and action research organisation. We promote sustainable development to improve livelihoods and protect the environments on which these livelihoods are built. We specialise in linking local priorities to global challenges. IIED is based in London and works in Africa, Asia, Latin America, the Middle East and the Pacific, with some of the world's most vulnerable people. We work with them to strengthen their voice in the decision-making arenas that affect them — from village councils to international conventions.

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