SYSTEMATIC MAP PROTOCOL

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What is the evidence for the contribution of forests to poverty alleviation? A systematic map protocol

Samantha H. Cheng[1*], Sofia Ahlroth[2], Stefanie Onder[2], Priya Shyamsundar[3], Ruth Garside[4], Patti Kristjanson[5], Madeleine C. McKinnon[6] and Daniel C. Miller[7]

Abstract

Background: Forests provide an essential resource that support the livelihoods of an estimated 20% of the global population. Forests are thought to serve in three primary roles to support livelihoods: subsistence, safety nets, and pathways to prosperity. While we have a working understanding of how poor people depend on forests in individual sites and countries, much of this evidence is dispersed and not easily accessible. Thus, while the importance of forest ecosystems and resources to contribute to poverty alleviation has been increasingly emphasized in international policies, conservation and development initiatives and investments—the strength of evidence to support how forests can affect poverty outcomes is still unclear. This study takes a systematic mapping approach to scope, identify and describe studies that measure the effect of forest-based activities on poverty outcomes at local and regional scales. This effort builds upon an existing systematic map on linkages between conservation and human well-being in order to make this process more efficient. We will conduct a refined and updated search strategy pertinent to forests-poverty linkages to glean additional evidence from studies outside the scope of the original map. Results of this study can be used for informing conservation and development policy and practices in global forest ecosystems and highlight evidence gaps where future primary studies and systematic reviews can add value.

Methods: We build upon the search strategy outlined in McKinnon et al. (Environ Evid 1–25, 2016) and expand our search to cover a total of 7 bibliographic databases, 15 organizational websites, 8 existing systematic reviews and maps, and evidence gap maps, and solicit key informants. All searches will be conducted in English and encompass all nations. Search results will be screened at title, abstract, and full text levels, recording both the number of excluded articles and reasons for exclusion. Full text assessment will be conducted on all included article and extracted data will be reported in a narrative review that will summarize trends in the evidence, report any knowledge gaps and gluts, and provide insight for policy, practice and future research. The data from this systematic map will be made available as well, through an open access, searchable data portal and visualization tool.

Keywords: Forestry, Safety nets, Subsistence, Community forestry, Co-management, Ecosystem services, Tenure rights

Background

Addressing sustainable use of natural resources and alleviating poverty is at the forefront of major global initiatives [1, 2]. Forests are emerging as a key arena of action in this dialogue. They drive a significant portion of the global economy while also providing critical ecosystem services, including massive carbon storage, management of natural water flows, erosion prevention [3] and habitat for 80% of terrestrial biodiversity. It is estimated that approximately 20% of the global population (~1.3 billion) relies on forests and forest products to support some portion of their livelihoods through sources of income

*Correspondence: cheng@nceas.ucsb.edu
[1] National Center for Ecological Analysis & Synthesis, University of California-Santa Barbara, Santa Barbara, CA, USA
Full list of author information is available at the end of the article

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and building materials to primary supply of food and water [4, 5]. Moreover, the majority of people living in or near forests in developing countries are also estimated to live below the extreme poverty line [6].

Organizations and governments at all scales are recognizing that sustaining natural resources is critical to achieving poverty alleviation and promoting global human well-being (e.g. Sustainable Development Goals 2015). Since the early 1990s, there has been substantial funding and investment in efforts such as Sustainable Forest Management (Global Environment Facility [7]), Reducing Emissions from Deforestation and Forest Degradation (REDD+) projects [8], and the European Union Forest Law Enforcement, Governance, Trade Action Plan (FLEGT) (2003). In parallel, as poverty alleviation is a primary policy goal for many international organizations, including the United Nations and the World Bank Group, increasingly, attention is paid to the role of forests. Specifically, the World Bank Group is targeting forest-based poverty alleviation strategies through investment lending operations, technical assistance as well as analytical work (Forest Action Plan FY16-20). For instance, the new Program for Forests (PROFOR) program on *Understanding forests' contribution to poverty reduction* is focusing not only on how forests contribute to the livelihoods of rural poor, but also potentially provide a pathway out of poverty.

While the link between sustainable resources and poverty is explicitly stated in numerous declarations, mission statements, strategies and initiatives—the nature of the linkage between ecosystems and poverty are complex and often unclear with little elucidation of the mechanisms connecting them [9, 10]. In part, the multi-dimensionality of poverty poses a significant challenge for policy development and implementation. Poverty can be defined as the deprivation of well-being related to lack of material income or consumption, low levels of education and health, vulnerability and exposure to risk, lack of agency, and powerlessness [5]. Thus, alleviating poverty through environmental improvement, will require clear hypotheses about how these different aspects of poverty respond, both individually and synergistically, to dynamic environmental and socio-economic factors, including ecosystem health, ecosystem service delivery, governance and access rights [11, 12].

Existing research shows that forests provide an essential contribution to income of both rural and urban communities [5, 13–15]. Estimates of dependence on forests vary, with studies suggesting that forests may contribute from a fifth, to more than a quarter, of the incomes of households living near forests [14]. The level of dependence on forest income varies based on regional, governance and ecological factors [16]. Forests can be assessed

along three different roles in relation to poverty. First, by offering subsistence, through incomes and consumption, second, as a "safety net" to prevent people from sliding into or further into poverty [17, 18], and third, as a pathway to prosperity [19, 20].

Subsistence

Forests provide a wide range of resources and benefits to poor people, from providing land for agricultural conversion, to timber, agroforestry and non-timber forest products and ecosystem services. Those living in or near forests draw substantial parts of their subsistence needs from forests. "Forest environmental income" refers to income (both cash and non-cash) derived from extraction from non-cultivated forest sources [14]. About half of this income is non-cash and includes food, fodder, energy, house-building materials, and medicine [21]. A meta-analysis of over 51 case studies from 71 countries indicates that forest environmental incomes represents on average 22% of total income for poor populations [19]. In addition, forests provide ecosystem services such as soil erosion reduction, water provisioning and water quality maintenance, which are important to sustain rural communities. Although the importance of forests for subsistence is well documented through case studies [22, 23] there are few reliable estimates of the value of subsistence benefits at the national or at the global scales.

Safety nets

The diversity of goods and services provided by forests serve as a significant safety net source or a gap-filler for the rural poor in times of instability, scarcity or stochasticity ([24], but see [18] for counter-argument). Research in developing nations shows that forests provide "natural insurance" in the form of alternative sources of income and subsistence to help cope with shocks [25]. In particular, forest income diversifies the income portfolio for all groups, but is particularly important for poor, rural households [13, 17]. There is a substantial set of literature that demonstrates how users turn to forests to supplement their incomes and smooth consumption. In particular, post shocks (e.g. floods, fires, pests, economic misfortunate, etc.), forests can serve as reserve areas for agricultural conversion [26], sources of emergency cash income [27, 28] and as a foraging resource [29, 30]. Forests also provide safety nets in the sense that they can reduce impacts of events such as floods and landslides (i.e. regulating ecosystem services).

Pathways to prosperity

Recently, forests are being thought of as not just safety nets in times of shock, but as a vehicle for poverty alleviation. Studies show that households who regularly use

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forest resources tend to have more cash savings [31, 32]. In addition, entry to forest-based livelihood options is relatively easy in comparison to other options and thus use of forests products could be a viable strategy even for the most destitute [33]. Thus, the use of forest resources may actually enable wealth and asset accumulation. Several case studies suggest that moving from poverty to relative prosperity is likely to be gradual, particularly for remote households with low levels of education and few employment opportunities, many of which are female headed households [3, 6]. Lastly, while less tangible, but no less important, forests and management of forest resources can also provide benefits to society such as clean environments, recreational services, cultural sites, and aesthetics, which can promote improved human health, empowerment, cultural integrity, individual happiness and social relations [34]. However, utilizing forest resources to eliminate poverty promotes increased use of limited resources—raising concerns over trade-offs between conserving ecosystems and achieving improved human well-being [35]. Thus, careful consideration of how to achieve the "triple bottom line" of equity, economic and environmental benefits, is needed.

A large body of evidence demonstrates that forests can be a source of day-to-day subsistence and a safety net in times of need. However, substantially less is known about how forests can serve as a pathway to prosperity through sustainable and substantial income streams, and the conditions under which these income streams can generate durable and/or productive assets [36]. Still less is known how different types of forest-related practices, programs and policies, under specific economic and social conditions, support or amplify the subsistence, safety net and asset accumulation functions of forests. While there have been a few systematic studies covering the role of forests and poverty, they have been limited in scope—focusing on one type of forest intervention on typically single-dimensional poverty [37–40]. Recently, two evidence gap maps from the International Initiative for Impact Evaluations (3ie) on the impact of forest conservation [41] and land use change [42] have helped illuminate this area. Both these maps provide broad assessments of the state of knowledge of the impact of these interventions on environmental and socio-economic outcomes, including poverty within a subset of forest types. However, these maps are still limited in scope in terms of geographies (low and middle income countries only) and interventions (policies and programs only; conservation actions only) examined. Moreover, the strict limitations of types of studies encompassed in these maps limit our perspectives on past and current trends in research effort and focus. Thus, a broad systematic understanding of the pathways and mechanisms by which forests can help the chronically poor become less poor, does not yet exist.

This study aims to address this gap by consolidating the existing evidence on forest-poverty linkages, synthesizing data on impacts for a specific linkage, and disseminating data and products to key decision makers in the forest sector. Clarifying and supporting these relationships is critical given global, as well as the World Bank Group's, commitment to eliminating extreme poverty by 2030 (notably, the Sustainable Development Goals). The World Bank Group's recent Forest Action Plan has sustainable forest management as one of its main pillars. It aims to support investments that increase the potential of forests to provide cash and non-cash income and to generate jobs and economic opportunities for forest-dependent people [15]. Our study seeks to strengthen existing knowledge on the potential contribution of forests to poverty reduction and shared prosperity, and foster more evidence to inform investment, priority setting and research priorities for forest management, globally.

Objective of the review
The objective of this systematic map is to identify, map and describe the global evidence on the effects of forest related activities[1] on poverty outcomes. We are particularly interested in welfare outcomes associated with changes in forest management (including governance structures) and markets for forest products and services. The formulation of this research question and the scope of this systematic map was commissioned by the World Bank Group's Program on Forests (PROFOR, http://www.profor.info). PROFOR is a multi-donor partnership which aims to provide knowledge, tools, and in-depth analyses to facilitate the contribution of forests to poverty reduction, sustainable economic development, and protection of global and local environmental services. Authors Ahlroth, Sieber, Kristjanson, Shyamsundar and Miller are (or were) World Bank staff working either directly with or supporting this program. This group of PROFOR stakeholders engaged in a planning meeting with the evidence synthesis team (Cheng, Garside, McKinnon) to agree upon the scope of this study and develop a conceptual framework of study, in order to help inform both PROFOR programmatic activity, as well as capture the scope of existing knowledge in order to help progress global efforts.

This systematic map builds on an already existing systematic map on linkages between conservation and human well-being in non-OECD nations [43, 44]. We will identify relevant evidence from the existing

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[1] Forest based activities include all activities involving extraction and/or management of resources (e.g. wood, food, commodities) that support human livelihoods.

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conservation-human well-being map and glean additional evidence from new systematic reviews and primary research studies outside the scope of the original map. Furthermore, this map expands upon the nascent efforts to synthesize evidence on the effects of forest programs and conservation (e.g. [37–39, 45]) by adding a global perspective on the state of evidence covering a wider definition of forests (see *Forest types* below), as well as a more comprehensive framework for examining poverty outcomes. The new map of forest-poverty linkages will contain evidence that can be used for informing policy and highlight evidence gaps where future primary studies and systematic reviews can add value.

By building a systematic forest-poverty map, we will address the following primary research question:

> *What is the evidence for the role of forests in contributing to poverty alleviation?*

Using the resulting evidence base, we aim to answer the following set of secondary research questions:

1. *What is the state of the evidence base on the effects of forest-based productive activities on poverty in terms of quantity of articles, study type, intervention type, outcomes measured, governance regime, ecoregions and geographical location?*
2. *What types of forest-based programs have been studied and how much evidence is there from different types of research?*
3. *What kind of indicators are commonly used as measures of poverty?*
4. *What are the major gaps in the evidence base from (a) primary research studies and (b) systematic reviews?*

Elements of the primary question
Population
Discrete human populations living within or near forested or formerly forested areas from all nations.

Exposure
Forest-based productive activities (see Table 2).

Comparator
Temporal (before/after, continuous time series, interrupted times series), spatial (distance), or between groups (control/intervention, socioeconomic, gender, racial/ethnic).

Outcome
Measures of poverty in terms forest-based income, consumption, capital, and assets (see Table 3).

Framework development
The framework for this systematic map was developed through a series of meetings and an expert workshop involving personnel from the World Bank Group, PROFOR, Conservation International, the National Center for Ecological Analysis and Synthesis (NCEAS), and the University of Illinois. During the workshop, the overall scope of the project was developed and agreed upon and refined. The framework used in this study reflects a synthesis of existing conceptual models on links between forests and poverty and ties into the ongoing programmatic activity on forests and poverty funded by PROFOR. Specifically, we draw from two primary sources, the forestry Living Standards Measurement Study (LSMS) sourcebook [46] and the P.R.I.M.E. framework [47] to define our intervention and outcome targets.

The P.R.I.M.E. framework is a conceptual framing that defines possible pathways through which forests may help lead people out of poverty and toward greater prosperity [47]. It categorizes five main pathways towards prosperity from forest-based interventions and actions, including productivity, rights, markets, investments and ecosystems (Box 1). P.R.I.M.E. argues that for forests to lead to poverty alleviation—actions must be taken to (a) improve in productivity (*P*) of land and labor; (b) strengthen community, household and women's rights (*R*) over forests and land; (c) make complementary investments (*I*) in institutions and public services integral to economic development; (d) increase access to markets (*M*) for timber and/or non-timber forest products (NTFPs); and (e) enhance and regulate ecosystem services (*E*), so that benefits accrue to the poor. The success of any one action could be contingent on the presence of others and on complementary safeguard policies to ensure forest and ecosystem survival and integrity.

The second framework we use is the LSMS sourcebook on national socioeconomic surveys in forestry or forestry LSMS sourcebook, which has been developed by the Food and Agriculture Organization (FAO), World Bank Group (LSMS and PROFOR), IFRI, and CIFOR as a standardized guide for conducting monitoring and evaluation of forest programs [46]. The forestry LSMS sourcebook aims to provide resource material and guidelines on collecting forest socioeconomic data and to contribute to better global statistics on values, products and services from forests and trees.

We utilize these two frameworks in conjunction to develop our systematic map. Specifically, we use P.R.I.M.E. to frame our typology of exposures for forest-based productive activities. We then use the poverty outcomes identified in the forestry LSMS sourcebook to frame our typology

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of poverty outcomes. This typology is based on indicators used by major development organizations [e.g. Sustainable Livelihoods Framework (DFID), World Health Organization, World Bank Group] and presents a well-rounded and comprehensive conceptualization of poverty. For consistence and comparability, we will use definitions of forest-based initiatives and measures of poverty outcomes from the forestry LSMS sourcebook as far as possible.

Box 1 P.R.I.M.E.—pathways toward prosperity (adapted from [47])

Five complementary pathways may help launch individuals and communities onto a sustainable path toward prosperity. These pathways, referred to as P.R.I.M.E., identify economic development strategies and build on the premise that forests themselves will remain intact

PRODUCTIVITY Growth in labor and resource productivity (P) is integral to economic development. In forested landscapes, labor productivity can be improved by augmenting individual and community skills in sustainable forest management. Resource productivity can be enhanced through capital infusion (for instance, portable saw mills for timber harvesting), forest fire and pest management or tree plantations. Any associated technologies and capacity strengthening activities would need to meet the needs of women, indigenous people and other marginalized households for the poorest to benefit

RIGHTS Wealth accumulation is a traditional pathway out of poverty. Thus, a second strategy is to increase the wealth of the poor by strengthening their rights (R) over natural capital. A large literature and local environmental movements point to the importance of community rights to use and sell forest resources in poverty reduction. Within forested communities, empowering women and other marginalized individuals with tenure rights and decision-making power is particularly important for poverty reduction

INVESTMENTS Poverty reduction in forested landscapes will not be possible without serious investments (I) in complementary institutions and public services. Forest-related pathways to prosperity are only likely if the poor also have inclusive and affordable access to complementary public services such as education, health, agricultural extension, transportation and mobile phone access. The role of gender-responsive institutional arrangements in providing information, enabling local level innovation and offering insurance from down-side risks will be important

MARKETS Income generation and diversification requires strengthening small and medium enterprises and increasing access to markets (M) for producers of timber and non-timber products. Markets for high-value non-timber forest products (e.g. Brazil or Shea nuts) offer one pathway that is likely to be beneficial to men and women. Timber certification and growth in export markets for small-holder wood products offer an alternate broader approach. This pathway may require support to producers to organize themselves to engage with larger markets

ECOSYSTEMS Ecosystems and their hidden services (E) are integral to prosperity. Over the last decade, a number of policy instruments have been developed to manage ecosystem services and strengthen their contribution to income and livelihoods. It is important to channel this increased recognition of and demand for ecosystem services into monetary and non-monetary benefits to the poor, and women within poor households

Methods

The methodology for building a forest-poverty evidence map includes two components: (a) establishing key search terms that capture the issues identified through the conceptual framework; and (b) developing the scope of the search and inclusion and exclusion criteria.

Searches

A comprehensive search will be undertaken using multiple sources of knowledge to best capture an unbiased representation of existing literature.

Search terms

We have compiled an initial set of English search terms relevant to different components of the research question (Additional file 1). This initial string of terms has been modified through a scoping exercise in Web of Science (Additional file 1) to examine for sensitivity given alternate terms and wildcards, as well as using input from PROFOR partners. Finally, this search string was tested and modified as needed by running it against a test library of relevant literature contributed by the expert advisory group from the World Bank Group and by experts in the field (Additional file 2).

Exposure terms "REDD+" OR "REDD" OR "Reduced emissions from deforestation and degradation" OR "FLEGT" OR "forest management" OR "forestry" OR "CBNRM" OR "community-based natural resource manag*" OR "resource manag*" OR "conservation agreement" OR "national park" OR "biosphere reserve" OR "nature reserve" OR "conservation area" OR "extractive reserve" OR "afforest*" OR "reforest*" OR "NTFP*" OR "non-timber forest product" OR "non timber forest product*" OR "silvicultur*" OR "silvi-cultur*" OR "PES" OR "payment for ecosystem services" OR "incentive*" OR "tenure*"

AND

Adjacent to "forest*" OR "woodland*" OR "agroforest*" OR "silvopast*" OR "coffee" OR "charcoal"

AND

Adjacent to "voluntary" OR "participatory" OR "collective" OR "public" OR "private" OR "commercial" OR "sustainable" OR "illegal" OR "community"

AND

Outcome terms "poverty" OR "income" OR "empower*" OR "job*" OR "livelihood*" OR "security" OR "attitude*" OR "capital" OR "traditional knowledge" OR "TEK" or "*equity"

Searching the literature

Search for relevant published and unpublished literature will be conducted within relevant systematic maps, bibliographic searches, online publication databases, and organization websites and repositories. This systematic map will build off a subset of data identified by broad scope systematic map on nature-based conservation and human well-being linkages [44]. This method saves significant resources and allows us to utilize existing information generated from evidence synthesis. In order to minimize bias in this targeted search method, we will

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first screen all forest-related literature from this map, followed by a search of their excluded literature to capture exposures that did not fall within the original scope of their study (e.g. agroforestry, silviculture, extractive or productive activities not for conservation purposes). Specifically, we conduct the following searches:

1. *Bibliographic searches* This map will include a subset of data specifically pertaining to forest ecosystems identified by McKinnon et al. [44] systematic map on conservation-human well-being linkages. Additionally, several relevant systematic reviews [37–39, 45], systematic maps [48], and evidence gap maps [41, 42] address questions of relevance to our scope. We will screen these articles for any included studies meeting our inclusion criteria. Depending on the volume of search results and time available from the research team, forward and backward searching of study bibliographies will also be conducted.

2. *Excluded literature* We will search excluded literature from the McKinnon et al. [44] systematic map using the search string below to look for articles meeting our inclusion criteria (e.g. plantation forestry, silvopastoralism).

3. *Publication database searches* We will search Web of Science (Core Collection 1900-Present, includes 10 indices), Greenfile (EBSCO), Econlit, Agricola, Agecon, Agris and CAB Abstracts. Selection of these databases were based upon previous systematic reviews on related topics [45]. We will search these databases for studies published from 2014 to 2016 to

account for articles published after original McKinnon et al. [44] search was conducted.

4. *Topical databases and organization searches* Targeted searches of specialist websites and databases will be conducted, in particular, of established online repositories of impact evaluations and systematic reviews on related topics to our research question. A list of websites is provided in Table 1.

5. *Stakeholders and topic experts* Key informants within PROFOR and their network of researchers will be contacted for relevant literature for screening and inclusion.

Reference management
The online literature review and reference management software, EPPI-Reviewer 4 [49], will be used to upload relevant titles and abstracts for candidate studies identified through the search strategy. A project workspace will be established to assist the research team in organizing and managing the sources of evidence (i.e., where possible studies were located) and the screening process.

Article screening and study inclusion criteria
Screening
Search results will be reviewed first at title, and subsequently at abstract to determine inclusion or exclusion. Depending on the volume of search results, double screening may be conducted for a small percentage of studies at the title and abstract stage. Consistency checking will be conducted using a two-step, double-blind method employed within EPPI-Reviewer 4 and

Table 1 List of organizations and databases to be searched

Database or organization	Web URL
Poverty and Conservation Learning Group	http://povertyandconservation.info/
International Impact Initiative (3ie)	http://www.3ie.org
Collaboration for Environmental Evidence	http://www.environmentalevidence.org
J-Poverty Action Lab	http://www.povertyactionlab.org
World Bank Development Impact Evaluation Initiative (DIME)	http://microdata.worldbank.org/index.php/catalog/impact_evaluation
DAI Evidence on Demand	http://www.evidenceondemand.info
International Food Policy Research Institute Library (IFPRI)	http://library.ifpri.info/
Center for International Forestry Research (CIFOR)	http://www.cifor.org
Ecosystem Services for Poverty Alleviation (ESPA)	http://www.espa.ac.uk/results/publications
Centre for Environmental Economics and Policy in Africa (CEEPA)	http://www.ceepa.co.za
Latin American and Caribbean Environmental Economics Program (LACEEP)	http://www.laceep.org
Economy and Environment Program for Southeast Asia (EEPSEA)	http://www.eepsea.org
South Asian Network for Development and Environmental Economics (SANDEE)	http://www.sandeeonline.org
World Agroforestry Center (ICRAF)	http://www.worldagroforestry.org
International Tropical Timber Organization (ITTO)	http://www.itto.int

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inconsistencies will be discussed and reconciled. Following training set of studies screened by all reviewers, inter-rater reliability will be calculated using a Kappa statistic for all studies double screening at title and abstract. Where a reviewer is uncertain about study inclusion, it will be marked for a second opinion and screening by a second reviewer will be conducted. A full list of excluded studies will be provided in the final narrative report as an additional file including reasons for exclusion.

Studies that meet the inclusion criteria at both the title and abstract stages will be reviewed at the full text stage. Any articles excluded at full text assessment will also be provided in an additional file detailing reasons for exclusion.

Inclusion criteria

To be included in the systematic map studies must meet the criteria outlined below. These criteria have been reviewed and confirmed with input from PROFOR and study partners.

Relevant population(s)

The term "forest-dependent people" is widely used to refer to rural poor populations that depend on forest resources in some way, particularly those in developing countries [16]. However, this term has faced criticism as there is little clarity and definition to who precisely this term includes [13], making it difficult to conduct cross-study comparisons, as this study attempts to do. In order to fully capture the impact of forest-based productive activities on poverty, this study focuses on the well-being of discrete human populations living within or near forested or formerly forested areas. We will include all studies on all groups of people from all nations, but will also disaggregate the data based on gender, income, age, and ethnicity in order to understand the distribution of impacts upon different stratifications of society, focusing on socio-economic stratifications in particular. We will exclude urban communities, who may not live near such areas but who may be dependent on forests (for fuelwood, for example).

Relevant exposure(s)

Exposures are structured per the P.R.I.M.E. framework ([47], Box 1) with specific definitions of actions deriving from the forestry LSMS sourcebook and the IUCN Conservation Measures Partnership Classification of Direct Actions (version 2.0) [50]. We will include studies that evaluate the impact or effectiveness of forest-based productive activities that fall within the following categories and subcategories (Table 2). We will also assess, where possible, broad complementary non-forest exposures in forested landscapes that affect household well-being.

Broad activity categories include Table 2, where there are overlaps between categories, studies may appear multiple times.

Relevant forest types

We will include studies related to forest ecoregions as defined by the World Wildlife Fund terrestrial ecoregion classifications [51] in all countries. These include tropical/subtropical moist broadleaf, dry broadleaf, coniferous forests and temperate broadleaf and mixed forests, coniferous forests, boreal forests/taiga, Mediterranean forests, woodlands, and scrubs, and mangroves. Within these forest ecoregions, we will include studies related to forests in any state ranging from old-growth natural forests to non-forest environments with planted trees, trees on farms or tree farms.

We follow the FAO definition of forests (also followed in the forestry LSMS sourcebook) of "land spanning more than 0.5 hectares with trees higher than 5 m and a canopy cover of more than 10%, or trees able to reach these thresholds in situ. It does not include land that is predominantly under agricultural or urban land use" [46]. This will be operationalized by excluding any studies that focus on agricultural or urban land use. It should be noted that "forests" may not necessarily correspond to the official definition of forests in any given country.

Relevant comparator(s)

Only studies that employ a valid comparator will be included. This does not mean that only quantitative impact evaluations based on experimental designs will be included, but that studies should target some measurement of change due to the intervention. As this study is attempting to describe the state and characteristics of the evidence base, we include a broad range of comparator and data types unlike a systematic review in order to provide insight on overall study quality (e.g. [44, 52]).

Comparators will be classified as temporal, spatial or between groups. Temporal comparators examine effects over time including before and after, interrupted or continuous time series and reported/perceived changes. Spatial comparators compare effects between sites over distance (e.g. near vs. far, linear distance). Lastly between group comparators compare effects between populations either of species/type of ecosystems or humans in relation to the intervention. This includes comparisons between presence/absence of an intervention.

Relevant outcomes

We will include studies that assess the impact of the above forest-based activities on poverty alleviation. We

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Table 2 Categories and subcategories of forest sector programs and policies with definitions

Category	Subcategory	Definition
Productivity		Actions to increase the short and long term production of forest resources (focusing on timber and NTFPs) and productivity and skills of resource harvesters and collectors
	Forest management	*Includes:* Forests that consist predominantly of indigenous vegetation, and with active management to increase the frequency and productivity of beneficial species. The management will include felling (trimming, thinning in addition to regular harvesting), forest restoration/regeneration (planting or/and seeding in process of afforestation or reforestation), fire surveillance, pest management and training and capacity building and training for these activities. Can include state, community, private sector and household controlled forests managed for timber and NTFP production. May include protected areas and buffer areas, if they allow harvest of forest resources. Also includes plantation forests
	Agroforestry	*Includes:* Land-use systems and technologies where woody perennials (trees, shrubs, palms, bamboos, etc.) are deliberately used on the same land-management units as agricultural crops and/or animals, in some form of spatial arrangement or temporal sequence. This includes practices such as silvopasture and home gardens. In agroforestry systems there are both ecological and economical interactions between different components
	Habitat management	*Includes:* Management of forest habitats to provide sustained ecosystem services, viable habitat for other non-extractive resources (e.g. livestock)
Rights and empowerment		Actions to strengthen formal and/or informal rights and responsibilities of forest-dependent communities and forest managers
	Governance	*Includes:* tenure rights (community, private, state-owned), use policies (forests and watershed), decentralization, forest user groups, forest department reform, forest acts and laws, monitoring, compliance, and enforcement (and associated consequences) that enable forest management and use of forests
	Individual rights/empowerment	*Includes:* property rights, access, participation in decision making (at the individual level)
Investments		Actions to provide and enhance non-forest investments, public services and institutions in areas close to forests in order to contribute to livelihoods of forest-dependent communities
	Produced capital	*Includes:* Building/investing in infrastructure (incl. roads, energy, telecommunications, water, sanitation); investing in equipment and machinery (improved cook stoves, biogas, substituting propagated products for wild products) as well as building/investing infrastructure for complementary activities (incl., tourism facilities, hydropower plants, and water treatment plants)
	Human capital	*Includes:* education, health communication, awareness building, and agricultural skills
	Social capital	*Includes:* Developing/building informal as well as formal institutions (incl. community councils, women's/youth groups, arbitration/courts middlemen/traders, service providers and credit/saving services). Identification, development and expansion of private sector agreements as well as industry practices and standards
Markets		Actions to add value to forest products (especially timber and NTFPs) and enhance access to wider markets
	Linked enterprises and livelihood alternatives	*Includes:* forest-linked industries (e.g. sawmills, furniture making); NTFP value addition and sale
	Identifying and strengthening market forces	*Includes:* certification of forest products (e.g. FSC, PEFC), value chain analyses; forest funds, forest taxes
	Increasing access to markets	*Includes*: forest producer networks that seek to combine forces to access markets; credit access for entrepreneurs (e.g. timber producers)
Ecosystems		*Actions to manage ecosystem services and promote their contribution to livelihoods and income*
	Managing and enhancing ecosystem services	*Includes:* Management and enhancement of ecosystem services for payments schemes (PES, REDD+ etc.) and ecotourism; can include identification, establishment or expansion of parks and other legally protected areas for improved management of ecosystem services
	Strengthening institutions and markets	*Includes:* Establishment of regulatory and monitoring systems to enable the creation of payment schemes (e.g. set up of benefit sharing mechanism, MRV system); Expansion of ecotourism actors, institutional arrangements for REDD+ and PES schemes
	Identifying non-monetary benefits	*Includes:* cultural and spiritual valuation of forests (e.g. designating sacred groves); valuation of forest services to support PES schemes (e.g. for REDD+, hydropower, water provision)

The definitions are synthesized and adapted from the forestry LSMS sourcebook [46], the P.R.I.M.E. framework [47], and the IUCN Conservation Measures Partnership Classification of Direct Actions version 2.0 [50]

use categories and subcategories of poverty outcomes as outlined in the forestry LSMS sourcebook [46] adapted to reflect forest-related outcomes only (Table 3).

Relevant study design(s)

We will include primary research articles meeting the criteria outlined below:

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Table 3 Categories and subcategories of poverty outcome measures

Category	Subcategory	Definition
Forest income and consumption	Monetary forest income—direct sale of goods	Individual/household monetary income from direct sale of forest goods
	Monetary forest income—wage labor	Individual/household monetary income from forest-based wage labor
	Monetary forest income—value addition/entrepreneurship	Individual/household/community monetary income from value addition to forest products and/or entrepreneurship
	Physical forest income—consumption	Individual/household physical income from consumption of forest goods
Capital/assets	Financial capital—credit, savings and debt	Value of individual assets from forest sources
	Natural capital—forest assets with access/use, sale and exclusion rights	Stock of forest asset individual has access right to
	Natural capital—land assets with access/use, sale and exclusion rights	Stock of land asset individual has access right to
	Physical capital—forest-based material assets	Stock of physical forest-based assets individual has access to
	Human capital—forest-based knowledge and skills	Individual knowledge and skills associated with uptake of forest-based intervention or improvement of practices
	Health	Measures of physical health, disease prevalence, and access to healthcare
	Social capital (including inequality, conflict, and empowerment of women and marginalized groups)	Measures of social resources that people draw on to make a living, such as relationships with either more powerful people (vertical connections) or with others like themselves (horizontal connections), or membership of groups or organizations. Generally relationships of trust, reciprocity and exchange that the poor can draw on in times of need, and that lower the costs of working productively together

- Non-experimental, quasi-experimental and experimental study designs that use quantitative, qualitative, or a combination of data types.
- Systematic reviews and reviews (e.g. systematic maps, evidence gap maps) that describe methods used for search, data collection and synthesis as per the protocol for the 3ie database of systematic reviews [53] and the Collaboration for Environmental Evidence guidelines. These will be noted and their references searched, time permitting.

We will exclude the following:

- Theoretical or modeling studies, purely qualitative research, editorials and commentaries will be excluded.
- Literature reviews which do not describe methods used for search, data collection and synthesis will also be excluded.

Study quality assessment

Due to the volume of studies we are likely to encounter and the wide breadth of study designs and comparators considered, we will not be critically appraising and assessing the quality of included studies. We recognize that this will limit interpretations from the resulting evidence map, however, we will communicate this limitation appropriately and fully within the resulting narrative report.

Data coding strategy

We will use a standardized data extraction form to extract descriptive data from all studies meeting our inclusion criteria. Data extracted from each study will include bibliographic details, exposure type, comparator details, outcome type and definition, governance or tenure type, population, biome/ecoregion, study design, geographical location and scale (spatial and temporal) (see Additional file 3). A complementary codebook will be created to explain the scope of each question in the data extraction form. We will conduct a pilot with a small subset of studies by everyone in the research team to ensure consistency and to resolve any issues or ambiguities. Judging from the volume of studies captured in other similar systematic reviews and maps with narrower focus (e.g. see [41, 44, 45, 54]), we will not conduct extensive side-by-side double extraction of data at the full text stage. Rather, random spot checks of a small percentage

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of included articles will be conducted to ensure consistency between reviewers. We will heuristically measure consistency using percent disagreement of spot-checking with the primary reviewer.

Study mapping and presentation

The final dataset will be formatted for statistical analysis in R to enable us to summarize key characteristics and trends. We will summarize the descriptive characteristics of the included studies according to the population, exposures, comparators, governance/tenure type, biome/ecoregion, study designs and outcomes, and may conduct additional analyses such as looking at number of studies published per year. We will upload the data into an online, open access data portal and tool to create a graphical, searchable, and interactive display of the existing evidence in terms of types of studies and the exposures and outcomes assessed in the current literature. We will use this to identify 'absolute' evidence gaps (where there is no literature evaluating impacts) and synthesis gaps (where there are literature documenting impacts but a lack of high quality systematic reviews synthesizing this information). Trends and patterns in the data along with relevant insights for policy, practice and research will be summarized in a narrative report in addition to the graphical display. Final data on excluded literature, included literature and associated meta-data will also be made available via an Excel spreadsheet.

Additional files

Additional file 1. Search results from initial scoping of online publication databases.

Additional file 2. Test library of candidate studies for inclusion.

Additional file 3. Data extraction form and codebook for coding data from studies.

Authors' contributions

MM, DM and SA conceived the study and secured funding support. SC wrote the manuscript and developed the parameters of the search strategy and inclusion/exclusion criteria with input from RG, DM, MM, SA, SO, PS, and PK. SC, RG, SO, SA and MM developed the data extraction strategy. SC implemented the scoping of the search strategy and will coordinate the review, data collection, analysis and presentation of the results. All authors read and approved the final manuscript.

Author details

[1] National Center for Ecological Analysis & Synthesis, University of California-Santa Barbara, Santa Barbara, CA, USA. [2] World Bank Group, Washington, DC, USA. [3] South Asian Network for Development and Environmental Economics (SANDEE), Kathmandu, Nepal. [4] European Centre for Environment & Human Health, University of Exeter, Truro, UK. [5] World Agroforestry Institute (ICRAF), Nairobi, Kenya. [6] Vulcan, Inc., Seattle, WA, USA. [7] Department of Natural Resources and Environmental Sciences, University of Illinois, Urbana, IL, USA.

References

1. Adams WM, Aveling R, Brockington D, Dickson B, Elliott J, Hutton J, Roe D, Vira B, Wolmer W. Biodiversity conservation and the eradication of poverty. Science. 2004;306:1146.
2. Griggs D, Stafford-Smith M, Gaffney O, Rockström J, Ohman MC, Shyamsundar P, Steffen W, Glaser G, Kanie N, Noble I. Policy: sustainable development goals for people and planet. Nature. 2013;495:305–7.
3. Agrawal A, Cashore B, Hardin R, Shepherd G, Benson C, Miller D. Economic contributions of forests. Backgr Pap Prep United Nations Forum For Tenth Sess 8–19 April 2013. 2013. p. 1–127.
4. FAO. State of the world's forests. 2014.
5. World Bank. World development report 2000/2001: attacking poverty. 2001.
6. Shepherd G. Rethinking forest reliance: findings about poverty, livelihood resilience and forests from IUCN's "livelihoods and landscapes" strategy. Gland IUCN. 2012.
7. UNFF. United nations forum on forests: report of the seventh session. Off Rec. 2007, Supplement No. 22. p. 1–11.
8. Skutsch MM, Ba L. Crediting carbon in dry forests: the potential for community forest management in West Africa. For Policy Econ. 2010;12:264–70.
9. Agrawal A, Redford K. Poverty, development, and biodiversity conservation: shooting in the dark? Wildl Conserv Soc Work Pap. 2006. p. 1–50.
10. McShane TO, Hirsch PD, Trung TC, Songorwa AN, Kinzig A, Monteferri B, Mutekanga D, Van Thang H, Dammert JL, Pulgar-Vidal M, Welch-Devine M, Peter Brosius J, Coppolillo P, O'Connor S. Hard choices: making trade-offs between biodiversity conservation and human well-being. Biol Conserv. 2011;144:966–72.
11. Kepe T, Saruchera M, Whande W. Poverty alleviation and biodiversity conservation: a South African perspective. Oryx. 2004;38:143–5.
12. Tekelenburg A, ten Brink BJE, Witmer MCH. How do biodiversity and poverty relate? An explorative study. Bilthoven; 2009.
13. Byron N, Arnold M. What futures for the people of the tropical forests? World Dev. 1999;27:789–805.
14. Angelsen A, Jagger P, Babigumira R, Belcher B, Hogarth NJ, Bauch S, Börner J, Smith-Hall C, Wunder S. Environmental income and rural livelihoods: a global-comparative analysis. World Dev. 2014;64:S12–28.
15. World Bank Group. Forest action plan FY16-20. 2016.
16. Newton P, Miller DC, Byenkya MAA, Agrawal A. Who are forest-dependent people? A taxonomy to aid livelihood and land use decision-making in forested regions. Land Use Policy. 2016;57:388–95.
17. Sunderlin WD, Belcher B, Santoso L, Angelsen A, Burgers P, Nasi R, Wunder S. Livelihoods, forests, and conservation in developing countries: an overview. World Dev. 2005;33((9 SPEC. ISS.)):1383–402.
18. Wunder S, Börner J, Shively G, Wyman M. Safety nets, gap filling and forests: a global-comparative perspective. World Dev. 2014;64:S29–42.

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19. Vedeld P, Angelsen A, Bojö J, Sjaastad E, Berg GK. Forest environmental incomes and the rural poor. For Policy Econ. 2007;9:869–79.
20. Angelsen A, Wunder S. Exploring the forest–poverty link: key concepts, issues and research implications. 2003. (CIFOR Occasional Paper).
21. Sjaastad E, Angelsen A, Vedeld P, Vedeld P. What is environmental income? Ecol Econ. 2005;55:37–46.
22. Kremen C, Niles JO, Dalton MG, Daily GC, Ehrlich PR, Fay JP, Grewal D, Guillery RP. Economic incentives for rain forest conservation across scales. Science. 2000;288:1828–32.
23. Reddy SRC, Chakravarty SP. Forest dependence and income distribution in a subsistence economy: evidence from India. World Dev. 1999;27:1141–9.
24. Wunder S. Poverty alleviation and tropical forests—what scope for synergies? World Dev. 2001;29:1817–33.
25. Dokken T, Angelsen A. Forest reliance across poverty groups in Tanzania. Ecol Econ. 2015;117:203–11.
26. Sunderlin WD, Angelsen AA, Wunder S. Forests and poverty alleviation. State World's For. 2003;2003:61–73.
27. Ogle B. People's dependency on forests for food security. In: Pérez MR, Arnold JEM, Byron Y, editors. Current issues in Non-timber forest products research: proceedings of the the workshop "Research on NTFP". Chap 12. Bogor: CIFOR; 1996. p. 219–42.
28. Noack F, Wunder S, Angelsen A, Börner J. Responses to weather and climate a cross-section analysis of rural incomes. Shock waves: managing the impacts of climate change on poverty, Policy Research working paper, no. WPS 7478. Washington DC: World Bank Group; 2015. p. 1–49.
29. Pattanayak SK, Sills EO. Do tropical forests provide natural insurance? The microeconomics of non-timber forest product collection in the Brazilian Amazon. Land Econ. 2001;77:595–612.
30. Völker M, Waibel H. Do rural households extract more forest products in times of crisis? Evidence from the mountainous uplands of Vietnam. For Policy Econ. 2010;12:407–14.
31. Shackleton C, Shackleton S. The importance of non-timber forest products in rural livelihood security and as safety nets : a review of evidence from South Africa. S Afr J Sci. 2004;100:658–64.
32. Shackleton S, Shackleton C. Rights, resources and rural development: community-based natural resource management in Southern Africa. In: Fabricius C, Koch E, Magome H, Turner S, editors. Rights, resources and rural development: community-based natural resource management in Southern Africa. Virginia: EARTHSCAN; 2004.
33. Dubois O. Forest-based poverty reduction: a brief review of facts, figures, challenges and possible ways forward. In: EFI proceedings, Saarijarvi, Finland. 2003.
34. Raymond CM, Bryan BA, MacDonald DH, Cast A, Strathearn S, Grandgirard A, Kalivas T. Mapping community values for natural capital and ecosystem services. Ecol Econ. 2009;68:1301–15.
35. Angelsen A. Policies for reduced deforestation and their impact on agricultural production. Proc Natl Acad Sci USA. 2010;107:19639–44.
36. Newton P, Oldekop JA, Brodnig G, Karna BK, Agrawal A. Carbon, biodiversity, and livelihoods in forest commons: synergies, trade-offs, and implications for REDD. Environ Res Lett. 2016;11:044017.
37. Bowler DE, Buyung-Ali LM, Healey JR, Jones JPG, Knight TM, Pullin AS. Does community forest management provide global environmental benefits and improve local welfare? Front Ecol Environ. 2012;10:29–36.
38. Pullin AS, Bangpan M, Dalrymple S, Dickson K, Haddaway NR, Healey JR, Hauari H, Hockley N, Jones JPG, Knight T, Vigurs C, Oliver S. Human well-being impacts of terrestrial protected areas. Environ Evid. 2013;2:1–41.
39. Leisher C, Temsah G, Booker F, Day M, Samberg L, Prosnitz D, Agarwal B, Matthews E, Roe D, Russell D, Sunderland T, Wilkie D. Does the gender composition of forest and fishery management groups affect resource governance and conservation outcomes? A systematic map. Environ Evid. 2016;4(1):1–13.
40. Pagiola S, Arcenas A, Platais G. Can payments for environmental services help reduce poverty? An exploration of the issues and the evidence to date from Latin America. World Dev. 2005;33(2 SPEC. ISS.):237–53.
41. Puri J, Nath M, Bhatia R, Glew L. Examining the evidence base for forest conservation interventions. International Initiative for Impact Evalutation (3ie). Evidence Gap Map Report 2016;4:1–70.
42. Snilstveit B, Stevenson J, Villar P, Eyers J, Harvey C, Panfil S, Puri J, McKinnon MC. Land-use change and forestry programmes evidence on the effects on greenhouse gas emissions and food security. 2016. (Evidence Gap Map Report).
43. Bottrill M, Cheng S, Garside R, Wongbusarakum S, Roe D, Holland MB, Edmond J, Turner WR. What are the impacts of nature conservation interventions on human well-being: a systematic map protocol. Environ Evid. 2014;3(1):1–16.
44. McKinnon MC, Cheng SH, Dupre S, Edmond J, Garside R, Glew L, Holland MB, Levine E, Masuda YJ, Miller DC, Oliveira I. What are the effects of nature conservation on human well-being? A systematic map of empirical evidence from developing countries. Environ Evid. 2016;5(1):1–8.
45. Samii C, Lisiecki M, Kulkarni P, Paler L, Chavis L. Effects of payment for environmental services (PES) on deforestation and poverty in low and middle income countries: a systematic review. Collab Environ Evid. 2013;2014:1–42.
46. FAO, CIFOR, IFRI, World Bank. National socioeconomic surveys in forestry: guidance and survey modules for measuring the multiple roles of forests in household welfare and livelihoods. 2016.
47. Shyamsundar PS, Ahlroth PK, Onder S. Investing in pathways to prosperity in forest landscapes–A P.R.I.M.E. Approach, World Bank. 2016.
48. Roe D, Fancourt M, Sandbrook C, Sibanda M, Giuliani A, Gordon-Maclean A. Which components or attributes of biodiversity influence which dimensions of poverty? Environ Evid. 2014;3:3.
49. Thomas J, Brunton J, Graziosi J. EPPI-reviewer 4: software for research synthesis. 2010.
50. IUCN. Conservation measures partnership: IUCN-conservation measures partnership conservation actions classification v. 2.0. 2016.
51. Olson DM, Dinerstein E, Wikramanayake ED, Burgess ND, Powell GVN, Underwood EC, D'amico JA, Itoua I, Strand HE, Morrison JC, Loucks CJ, Allnutt TF, Ricketts TH, Kura Y, Lamoreux JF, Wettengel WW, Hedao P, Kassem KR. Terrestrial ecoregions of the world: a new map of life on earth. Bioscience. 2001;51:933.
52. Haddaway NR, Bernes C, Jonsson B-G, Hedlund K. The benefits of systematic mapping to evidence-based environmental management. Ambio. 2016;45:613.
53. Snilstveit B, Eyers J, Bhavsar A, Gallagher E, Stevenson J. 3ie database of systematic reviews in international development: search strategy and procedures document. London; 2014.
54. Roe D, Sandbrook C, Fancourt M, Schulte B, Munroe R, Sibanda M. A systematic map protocol: which components or attributes of biodiversity affect which dimensions of poverty? Environmental Evidence. 2013;1(2):1–8.