Systematic Review Protocol

Title
What impact do trees outside of forests have on human well being outcomes in South Asia?

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Background
Trees outside forests (ToF) can provide several ecosystem services or benefits such as carbon sequestration, biodiversity conservation and soil enrichment (Castle et al., 2021; England et al., 2020; Peros et al., 2022; Santos et al., 2019). These benefits, largely focused on agri-silvipastoral systems, have been well studied and documented. For example, a recent meta-analysis by Peros et al. (2022) on ToF found that 86.8% of the cases in the analysis provided regulating services, such as carbon sequestration. Human wellbeing outcomes of ToF, on the other hand, are relatively less understood. South Asia, in particular, is an important region to study given the cultural norm of trees outside forests (Dhyani et al., 2021; Kumar et al., 2012). This regions is home to millions of small-scale farmers, with often less than 4 hectares each, where trees are an important source of fodder, nutrition, and livelihoods. Moreover, countries in South Asia such as India have large land restoration targets such as restoring 26 million hectares of degraded land by 2030 (The Bonn Challenge, 2022), and recent studies have indicated that ToF may be an important aspect of meeting this pledge (Choksi et al., 2023; Gopalakrishna et al., 2022). This systematic review aims to understand the reported benefits and drawbacks for human wellbeing of ToF and the circumstances under which these outcomes are perceived by people. We aim to examine the biophysical, institutional, geographic, managerial and population characteristics that mediate the human wellbeing outcomes directly measured by a study or perceived by the population considered in a particular study. In the context of this review, we broadly use the term human wellbeing, to include the following components: material and living standards, health, education, work and leisure, agency and political voice, social relationships, physical and economic security (as defined by Rogers et al., 2012).

Theory of change or causal model
There exists a large body of work on the environmental outcomes (often in the context of ecosystem services) of trees outside forests (ToF) (e.g.: Castle et al., 2021; Kuyah et al., 2019; Santos et al.,

2019). However, less is known about the human wellbeing outcomes of ToF or incorporating trees into agricultural systems. Based on previous peer-reviewed case studies, we present a theory of change (Figure 1 attached). We posit that having ToF can lead to positive intermediate developmental outcomes that produce positive human wellbeing outcomes. However, contextual factors at different spatial scales influence these outcomes.

Stakeholder engagement

The authors listed above formulated the questions for this review. We did not engage with other stakeholders, for example farmers or civil society groups to develop this research question.

Objectives and review question

The objective of this review is to quantify the human wellbeing outcomes of ToF practices. Specifically, we ask the following question: (a) What are the human wellbeing outcomes of ToF in South Asia? If the data considered in the review allows for a more in-depth analysis, we aim to answer the following questions: (b) How do different densities and diversities of ToF drive the human wellbeing outcomes identified in the review? (c) How do contextual factors, such as biophysical, institutional and population characteristics, mediate the human wellbeing outcomes of ToF?

Definitions of the question components

We follow the PICO (Population, Intervention, Comparator, Outcomes) framework. We add one more component to this framework - Context. Context describes the biophysical, institutional, tenurial and population characteristics that could mediate the human wellbeing outcomes. Population: households with land holdings or landless rural households or communities that hold land communally. Intervention of interest: Trees outside legally classified forests (ToF) that are planted or exist naturally. We use the different terms for ToF as defined in Miller et al. (2017) and Malkami et al. (2020) (Table 1). Wherever possible, we will note the density and diversity of TOF in the studies reviewed. Comparator: Household/ local community that does not adopt practices included in ToF and/or household/ local community before it adopts practices included in ToF Outcomes of interest: Human wellbeing outcomes listed in Table 2. Context: We adapt some of the contextual factors listed in Newton et al. (2015) (Table 3).

Search strategy

We will search both biographical databases and organizational websites. Appendix A provides a search narrative and the exact search terms/ strings used in this review. Sections 8.1, 8.2 and 8.3 provide more details about our search strategy.

Bibliographic databases

The bibliographic databases are all accessed with the University of Minnesota subscription and include the following: SCOPUS ProQuest: Econlit OVID: Agricola Web of Science: Core Collection OVID: CAB Abstracts AGRIS ProQuest: Agricultural and Environmental Science database

Web-based search engines

We will not include web-based search engines in this review.

Organisational websites

We will search the following organizational websites using the search term "trees outside forests". The search will follow the same eligibility criteria as followed for the peer review literature search. Asian Development Bank Aid Data Australian Centre for International Agricultural Research (ACIAR) Center for Global Action Center for International Forestry Research (CIFOR) The Center for People and Forests Collaboration for Environmental Evidence Conservation Evidence Economy and

Environment Program for Southeast Asia (EEPSEA) Ecosystem Services for Poverty Alleviation Food and Agriculture Organization (FAO) French Agricultural Research Centre for International Development GFIS Global Landscapes Forum IDEAS RePEc (Research Papers in Economics) Indian Council for Agriculture Research (ICAR) Inter-American Development Bank (IADB) International Food Policy Research Institute Library (IFPRI) International Institute for Environment and Development International Impact Initiative (3ie) International Tropical Timber Organization International Union of Forest Research Organizations International Union for the Conservation of Nature J-Poverty Action Lab Nepal Agroforestry Foundation (NAF) Overseas Development Institute Trees outside Forests India Program (TOFI) Tropical Agricultural Research and Higher Education Center (CATIE) United Nations Development Programme (UNDP) United Nations Environment Programme (UNEP) UK Department for Environment Food and Rural Affairs United States Agency for International Development (USAID) USAID Development Experience Clearinghouse World Agroforestry Center (ICRAF) World Resources Institute The Nature Conservancy Foundation for Ecological Security (India)

Comprehensiveness of the search
We consider both peer-reviewed and gray literature for this review, which comprehensively addresses the research objective. Further, we have tested this protocol against seed articles over five iterations (refer to Appendix A for details on the search strategy), to ensure that our search strategy is appropriate for our research objective.

Search update
We will set up search alerts on Web of Science and Scopus for the duration of the screening of publications for this review. If the study takes over two years to complete and publish, we will update our searches.

Screening strategy
For peer-reviewed publications, we will import all the search results in Covidence and the duplicate results will be removed. First, a random set of 50 search results will be screened by each of the reviewers to check the level of agreement within the reviewers. After a consistency check, each search result will have two reviewers independently screening it to determine the appropriateness of the result in this review. The screening will be carried out based on the title and abstract. If the two reviewers are in agreement, the search result will be included in this review. If there is disagreement amongst the reviewers, the study will be reviewed by a third reviewer. The same process will be followed for full text screening to determine the final set of publications to be included in this review. All studies will be downloaded from Zotero, and those not available through Zotero will be manually downloaded. For gray literature, we will carry out this procedure outside Covidence. Search results that satisfy the inclusion and exclusion criteria will be included. The same screening procedure as used in Covidence will be used for gray literature. All extracted data will be downloaded from Covidence as a .csv file to further analyze it quantitatively. We will maintain a spreadsheet to record all the studies which were accepted or rejected after the full text review to report this in the systematic review.

Eligibility criteria
Below are the factors considered in determining the eligibility of a study to be included in this review: Setting or world region(s): India; Sri Lanka; Bangladesh; Nepal Population: Households/ communities in rural households. Study design/publications of interest: We consider observational and quantitative (quasi-) experimental or impact evaluation studies in peer-reviewed literature accessible to the UMN libraries. The articles are in English language. We exclude theoretical or modelling peer-reviewed studies and non-primary literature (e.g.: systematic reviews). We also consider high quality gray literature from non-governmental organizations/ academic institutions.

Consistency checking

Before beginning the review of all articles, we will remove a random set of 50 search results in Covidence in order to check for the consistency amongst all reviewers. In the event of coding disagreements, they will be discussed. The resolutions from the discussion will inform the any changes to the eligibility criteria. specifically the inclusion and exclusion criteria, will be made. Thereafter, each search result will be reviewed independently by two reviewers. If there is a disagreement a third reviewer will review the search result.

Reporting screening outcomes

We will adhere to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) reporting guidelines to report screening outcomes. We will include the PRISMA diagram in the final systematic review for the readers' reference.

Study validity assessment

We will use a Critical Systematic Appraisal checklist for all full text papers (https://casp-uk.net/casp-tools-checklists/).

Consistency checking

The Critical Systematic Appraisal checklist will be used for every full text paper considered in this review. Each publication will be reviewed by two authors. The checklist for each publication will be compared for each publication that is considered.

Data extraction strategy

All studies will be downloaded from Zotero, and those not available through Zotero will be manually downloaded. For gray literature, we will carry out this procedure outside Covidence. Search results that satisfy the inclusion and exclusion criteria will be included. The same screening procedure as used in Covidence will be used for gray literature. All extracted data will be downloaded from Covidence as a .csv file to further analyze it quantitatively. We will maintain a spreadsheet to record all the studies which were accepted or rejected after the full text review to report this in the systematic review. Appendix B provides a list of the data and meta data we will extract from the publications considered in this study.

Meta-data extraction and coding strategy

We will extract data on the publication as well as it's meta data, which includes the first author, collaborating authors, possible conflicts of interest, publication year, title and type of publication and the name of the journal. Appendix B provides a list of meta data we will extract from the publications considered in this study. Further, the Appendix also provides the exact coding strategy for the meta-data.

Consistency checking

Each publication's data and meta-data will be reviewed by two authors. In the case of a disagreement, a third reviewer will review the data and meta-data.

Potential effect modifiers/reasons for heterogeneity

We expect there will be heterogeneity across the studies due to differences in study design and data collection methods. For example, there could be the absence of a control group for treatment groups of people engaging in ToF and there could be differences in the categorization of social benefits from ToF, which would need to be recorded for quantitative analysis. This list is not exhaustive and we may expand the list as we continue the review process.

Type of synthesis

We will take a narrative and quantitative approach to synthesizing the publications on social outcomes of ToF.

Narrative synthesis methods
We will provide a narrative synthesis of data extracted for this systematic review. We will provide the spatial distribution of the studies within South Asia.

Quantitative synthesis methods
Our methods of analysis will be determined by the final dataset that we have from the review process. Based on the publications included in the review, we will code the human wellbeing outcomes and the density and diversity of trees outside forests in as much detail as possible. We aim to use different methods including machine learning and non-parametric statistical methods, such as causal forests and network analyses, to understand the social outcomes of ToF and its associations with certain local quantifiable conditions. In Appendix B we provide details on how the data will be coded for this review.

Qualitative synthesis methods
NA

Other synthesis methods
NA

Assessment of risk of publication bias
Depending on the final set of publications that are accepted for this systematic review, we will assess the publication bias.

Knowledge gap identification strategy
There is a lot of information on the ecological outcomes of ToF. However, our understanding of the human wellbeing outcomes of ToF is limited. This systematic review aims to understand the reported benefits and drawbacks for human wellbeing of ToF and the circumstances under which these outcomes are perceived by people. Our methods of analysis will be determined by the final dataset that we have from the review process. However, we aim to use different methods including machine learning and non-parametric statistical methods to understand the social outcomes of ToF.

Demonstrating procedural independence
To ensure impartial screening, reviewers who are authors of publications identified in the search results will not screen, assess or extract data from those specific papers at any stage of the review process. Instead, we will assign two reviewers who are impartial with no interest in the publication.

Competing interests
The authors of this systematic review have no competing interests to declare.

Funding information

Author's contributions
PC and FF conceived this study. PC, MK and FF developed the review protocol with input from all the authors. MK and PC will extract the data. PC, SD, ID, HF, FF, and TP will screen the data to be included in this study and PC will analyze the data. PC will write the first draft and all authors will contribute to the revision of the manuscript.

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