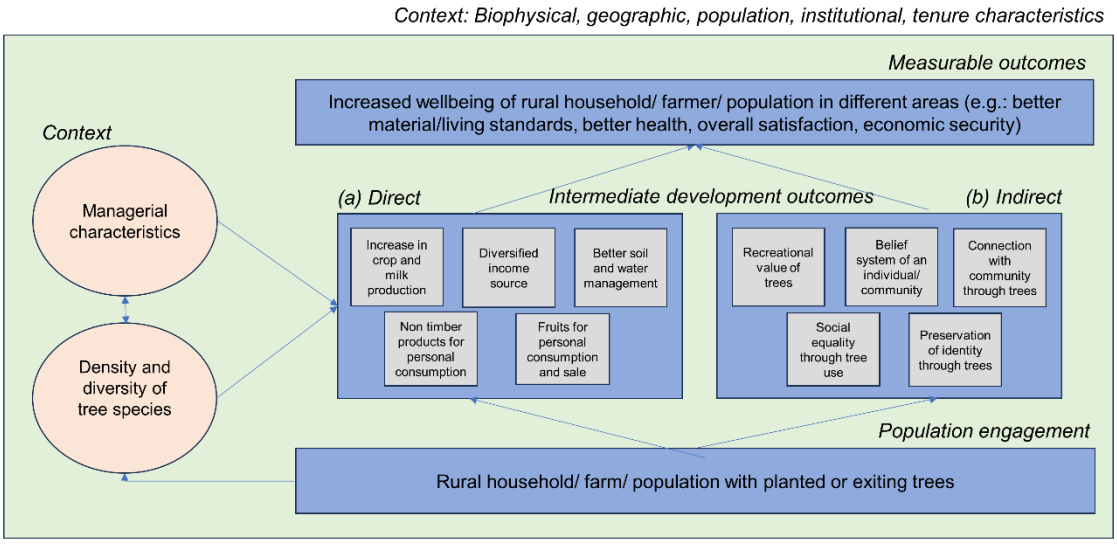

Figure 1: A theory of change model for human wellbeing outcomes linked to trees outside forests. Model adapted from Miller et al. (2017).

Table 1: List of Trees outside Forests (ToF) practices taken from Miller et al. (2017) and Malkamaki et al. (2020).

ToF system	ToF practice	Description of ToF practice
Agrisilvicultural system (crops and trees in one plot)	Improved or rotational fallow	Land resting system using trees and shrubs to replenish soil fertility, sometimes in rotation with crops as in traditional shifting cultivation
	Multipurpose trees on farms or lots	Scattered trees in parklands (landscapes derived from agricultural activities) or other land area or in systematic patterns on bunds, terraces or plot/field boundaries
	Mixed plantation crops	Combination of plantation crops in an intercropping system in alternate arrangement, including use of shade trees for cash crops
	Alley cropping	Planting rows of trees with a companion crop grown in the alleyways between the rows
	Shelterbelts/ hedgerows/ windbreaks	Extended windbreak of living trees and shrubs established and maintained to protect farmlands (beyond a single farm)

	Tree garden	Cultivation of a mixture of several fruit and other useful trees, sometimes with the inclusion of annual crops. This arrangement is sometimes referred to as homegardens
Silvopastoral (pasture/ animals and trees in one plot)	Live fences/ shelterbelts	Trees as fences around plots and/or an extended windbreak of living trees and shrubs established and maintained to protect farmlands and provide fodder
	Multipurpose fodder trees or shrubs around farm/ plot	Production of protein-rich tree fodder on farm/rangelands.
	Integrated production of animal/dairy and wood products	Production of animal/dairy and wood products within the same land area.
	Trees or shrubs on cattle pasture lands	Trees scattered irregularly or arranged according to some systematic pattern.
	Meadow orchards	Areas with planted fruit/nut bearing trees which are grazed or sown pastures
Agrosilvopastoral (pasture/ animals, crops and trees)	Integrated production of animals (meat and dairy), crops, and wood/fuelwood	Production of crops, animal/dairy and wood products within the same land area, including around homesteads.
	Woody hedgerows for browsing, green manure, soil conservation	Multipurpose woody hedgerows for browse, mulch, green manure, soil conservation, etc.
	Wooded pasture products	Land covered with grasses and other herbaceous species, and with woody species
	Riparian buffer strip	Tree plantation along river beds or streams
Agroforestry including insects/ fish	Entomoforestry	The combination of trees and insects (e.g. bees for honey and trees)
	Aqua-silvo-fishery	Trees lining fish ponds, tree leaves being used as 'forage' for fish
Tree plantation	Tree farm (mixed or monocultures)	Mixed species or monoculture tree plantation on a plot
	Afforestation	Growing trees on land outside forest areas

	Reforestation	Regrowing trees on land that has been deforested
	Orchard	Typically planting of fruit-bearing trees or other seed/ nut bearing trees

Table 2: List of possible indicators for each domain of human wellbeing outcomes. This list has been compiled from Miller et al. (2017), Pfeifer et al. (2023) and Rogers et al. (2012). This list is not exhaustive.

Domain of human wellbeing outcomes	**Example indicators of wellbeing**
Material and living standards	• Access to biomass, fuelwood, fiber, housing materials or other materials from plants for direct use or processing • Water availability from surface or ground water for non-drinking purposes • Access to basic infrastructure including electricity, water, transportation or telecommunications • Access to movable and non-movable assets • Access to adequate shelter • Ownership of livestock
Health	• Protection from disease • Provision of elements/ access to medical resources or health care needed for good health, health care and birth control • Physical and mental health • Longevity and life expectancy • Access to health insurance • Access to diversified diet
Education	• Access to educational opportunities • Access to vocational training opportunities
Work and Leisure	• Access to nature • Satisfaction with overall quality of life

	• Satisfaction with livelihoods • Time and space for recreation • Freedom to move about and choose job, home, and social • relationships • Ability to have a belief system and sense of meaning
Agency and Political voice	• Ability to have a political voice • Autonomy and self-determination
Social relationships	• Recognition in village/ community • Social equality with others (non-discrimination) • Strong community and social interactions • Ability to trust others
Physical and Economic security	• Total household income and expenditure • Provision of farm and non-farm income, • Employment/ Diversified incomes • Access to loans • Lack of debt • Access to financial savings • Opportunity for land ownership • Provision for dependents • Provision for self in old age • Livelihood diversification

Table 3: Contextual factors considered in this study.

Category	**Contextual factor**	**Possible source of data to include contextual factor into analysis of wellbeing outcomes**
Population characteristics	Education level of population	From publication, Latest census data
	Forest dependence of population	From publication
	Remoteness of population	From publication; Nightlight data; Global Friction Surface
	Existing poverty levels of population	From publication
	Heterogeneity of population	From publication
	Population density	Latest census data
	Population	Latest census data
Institutional characteristics	Tenure security	Landmark 2021 tenure data

	Individual and minority rights	Varieties of Democracy (V-Dem) Project SHRUG 2.0
	Local autonomy	From publication
Biophysical and geographic characteristics	Elevation	NASA SRTM Digital Elevation Data Version 4
	Slope	NASA SRTM Digital Elevation Data Version 4
	Precipitation	CHIRPS
	Ecoregion	WWF Terrestrial Ecoregions of the World
	Region of water scarcity	From publication
	Remoteness (by road density)	From publication, remotely-sensed public dataset
	Proximity to a forest (patch) where possible	Global Forest Watch (multiple years available)
Managerial characteristics	Third party certification	From publication
	Tree species characteristics (Fast or slow growing species)	From publication
	Tree species characteristics (Native or Non-native)	From publication

Appendix A: Search Narrative

Database: CAB Abstracts <1973 to 2023 Week 30>
Host: Ovid
Date Searched:
Searcher: MK
Date parameters: 1973 to present
Hits: 2770

Purpose/Concept	**Line #**	**Search Strategy**	**Hits**	**Notes**

	1	("agroforest*" or "agriforest*" or "agro-forest*" or agrosilvicultur* or agrisilvicultur* or "improved fallow*" or "shade tree*" or "rotational tree fallow*" or parkland* or "multipurpose tree*" or "tree garden*" or "forest garden" or "alley cropping" or intercropping or "shifting cultivation" or shelterbelt* or "natural vegetation strip*" or "wind break*" or "sloping agricultural land technology" or "hedgerows" or "hedge cropping" or silvopastoral* or silvipastoral* or "fodder tree*" or "living fence*" or "integrated animal and wood production" or "trees on pasture" or agrosilvopastoral* or "integrated production of animals, crops and wood" or "tree-crop-livestock" or "apiculture with trees" or entomoforestry or "aqua-silvo-fisher*" or "multi-purpose tree lot*" or "orchard" or "woody hedgerows" or "wooded pastures produce" or "fertili?er trees" or "shade species" or "shade-grown" or "alternative agriculture" or "tree-based system*" or "tree fallow*" or "planted fallow*" or woodlot* or "boundary planting" or "mixed trees and crops" or "conservation agriculture with trees" or "farmer managed natural regeneration" or homegarden or "fodder shrub*" or "multi-strata systems" or "nitrogen fixing trees" or "tree* outside forest*" or (tree* adj2 farm*)).ti,ab.	92037	These terms were adapted from Miller et al (2017) with the addition of "tree* outside forest*". Originally a search was tried using a broader set of terms like "forest" but this brought in too many irrelevant articles such as anything that used a forest plot for statistical analysis. It was determined that combining these specific terms with the subject headings in line 2 would be sufficiently broad and captured all of the articles in our test set. .ti,ab. indicates that titles and abstracts were searched for these terms.
	2	agroforestry/ or Community forestry/ or Farm forestry/ or Private forestry/ or Seed orchards/ or Social forestry/ or exp Agroforestry systems/ or agronomy/ or forestry/ or plantations/ or orchards/ or Plantation crops/ or hedges/ or Hedgerow trees/ or Live fences/ or windbreaks/ or agrosilvicultural systems/ or multipurpose trees/ or exp trees/ or afforestation/ or tree fruits/	437535	These subject headings from the CABI thesaurus were harvested from the test set of articles and from searching the thesaurus for the keyword terms in line 1.
Trees outside forests	3	1 or 2	485161	This line combines all the keywords and subject headings for the concept of trees outside forests.

	4	(Livelihood* or conflict* or welfare or well being or income or employment or job or subsistence or labor or socioeconomic* or socio economic* or social or economic* or perception* or poverty or infrastructure or outgrow* or customary right* or land right* or property right* or tenure or migration or displacement or gender or health or ownership or access or benefit sharing or food security or income or climate security or cultur*).ti,ab.	2403038	This list of terms was developed by a subject-matter expert (PC) in combination with terms harvested from sample articles. Some terms such as "power" and "cultur*" were tested and removed from this list because they were determined to be too vague or too broad to be useful. .ti,ab. indicates that titles and abstracts were searched for these terms.
	5	Food security/ or employment/ or socioeconomics/ or Rural economy/ or legal rights/ or economic impact/ or poverty/ or poverty alleviation/ or hunger/ or basic needs/ or deprivation.mp. or exp social indicators/ or exp disparity/ or exp social status/ or migration/ or exp attitudes/	373095	These subject headings from the CABI thesaurus were harvested from the test set of articles and from searching the thesaurus for the keyword terms in line 4.
Social outcomes	6	4 or 5	2472455	This line combines all the keywords and subject headings for the concept of social outcomes.
	7	(household* or small holder or rural or local community or indigenous or ethnic or tribal or farm owner* or farmland owner* or traditional).ti,ab.	649667	This list of terms was developed by a subject-matter expert (PC) in combination with terms harvested from sample articles. .ti,ab. indicates that titles and abstracts were searched for these terms.
	8	Rural areas/ or communities/ or small farms/ or traditional farming/ or smallholders/	177218	These subject headings from the CABI thesaurus were harvested from the test set of articles and from searching the thesaurus for the keyword terms in line 7.
Smallholder farms	9	7 or 8	706345	This line combines all the keywords and subject headings for the concept of small-holder farmers.
	10	(India* or Nepal* or Sri Lanka* or Bangladesh* or South Asia*).ab,cp,gl,lp,sh,ti.	933834	These terms for South Asia were provided by author PC.
South Asia geography filter	11	exp south asia/	616366	The exploded subject heading of south asia includes the subheadings: Bangladesh, Bhutan, India, Nepal, Pakistan, and Sri Lanka .ab,cp,gl,lp,sh,ti. indicates that the fields searched for

				these terms were abstract, country of publication, geographic location, location of publisher, subject heading, and title.
	12	10 or 11	933834	This line combines all the keywords and subject headings for the geographic area of South Asia.
Search logic	13	3 and 6 and 9 and 12	3306	This line combines the three main concepts (trees outside forests, social outcomes, and smallholder farms with the geographic filter)
Tree/forest filter	14	(tree* or forest* or agroforest*).ti,ab,sh.	1019837	This line is an additional filter for variations of the terms tree, forest, or agroforestry. .ti,ab,sh. indicates that one of these words must appear within the title, abstract, or subject heading fields.
	15	13 and 14	2817	This line applies the tree/forest filter to the combined concept and geography set. Testing against our test set of articles showed that this reduced noise without losing relevant articles.
Language filter	16	limit 15 to english language	2770	This line limits results to those published in English.

Test set articles:

Anil, R., Man, S., & Pathak, G. M. (2000). A study of agroforestry in Chhachhroli block of Yamuna Nagar district of Haryana state. *Annals of Agricultural Research*, *21*(1), 17-22.

Chauhan, S. K., Nanda, R. K., & Brar, M. S. (2009). Adoption of poplar-based agroforestry as an approach for diversified agriculture in Punjab. *Indian Forester*, *135*(5), 671.

Datta, P., & Behera, B. (2022). Factors influencing the feasibility, effectiveness, and sustainability of farmers' adaptation strategies to climate change in the Indian Eastern Himalayan Foothills. *Environmental Management*, *70*(6), 911-925.

Dube, L. C., & Chatterjee, S. (2022). Assessing livelihood impact of forest carbon projects using sustainable livelihood framework. *Mitigation and Adaptation Strategies for Global Change*, *27*(8), 49.

Gosain, D. K. (2007). A case study: diversification in agriculture through horticultural crops-a study of Bilaspur District of Himachal Pradesh. *Asian Journal of Horticulture*, *2*(2), 288-290.

Koju, U., Karki, S., Shrestha, A., Maraseni, T., Gautam, A. P., Cadman, T., Sherpa, A. P., & Lama, S. T. (2023). Local stakeholders' priorities and perceptions towards forest ecosystem services in the Red panda habitat region of Nepal. *Land Use Policy*, *129*, 106657. https://doi.org/10.1016/j.landusepol.2023.106657

*Kuyah, S., Whitney, C. W., Jonsson, M., Sileshi, G. W., Öborn, I., Muthuri, C. W., & Luedeling, E. (2019). Agroforestry delivers a win-win solution for ecosystem services in sub-Saharan Africa. A meta-analysis. A*gronomy for Sustainable Development*, 39(5), 47. https://doi.org/10.1007/s13593-019-0589-8

*Malkamäki, A., D'Amato, D., Hogarth, N. J., Kanninen, M., Pirard, R., Toppinen, A., & Zhou, W. (2018). A systematic review of the socio-economic impacts of large-scale tree plantations, worldwide. *Global Environmental Change*, 53, 90–103. https://doi.org/10.1016/j.gloenvcha.2018.09.001

Verma, D. P. S. (1990). Agroforestry practices of Gujarat state. *International Tree Crops Journal*, *6*(1), 17-30.

Viswanath, S., Nair, P. K. R., Kaushik, P. K., & Prakasam, U. (2000). Acacia nilotica trees in rice fields: A traditional agroforestry system in central India. *Agroforestry systems*, *50*, 157-177.

** indicates articles that were used initial exploratory searching before Geographic limit was determined*

Appendix B: Data coding for quantitative analysis

We adapt data coding methods from Reed et al. 2017 for this review. Below are the columns used to code information after a full text screening from each publication considered in this review.

I. Publication

A. **Case study ID:** Unique identifier for each publication included in the review.
B. **Reviewer 1:** Each publication will go through a full text screening by two reviewers. Reviewer 1's name will be listed in this column.
C. **Reviewer 2:** Each publication will go through a full text screening by two reviewers. Reviewer 2's name will be listed in this column.

II. Bibliography

A. First author: Name of first author of the publication
B. Collaborating authors: Name of all other authors of publication
C. Possible conflict of interest in author's affiliations or funding sources: Note any conflict of interest in the publication. If a conflict of interest exists, the publication will be removed from the review.
D. Publication year
E. Title of publication
F. Type of publication: Book, Book chapter, Conference paper, Conference proceedings, Journal article, Report (organizational), Policy brief, Working paper, PhD thesis, MSc thesis
G. Journal name or organization

III. Methodology

A. Year(s) that the study covers: " ; " indicate multiple separate years and " - " indicate a range of years.

B. **Type of study:** Quantitative, Qualitative, Mixed

C. **Study design:** Observational, (quasi-) experimental, field trial, non- experimental (where no control group was selected)

D. **Data collection methodology:** Household-level surveys, Administrative area-level surveys, Key informant interviews, Focus group interviews, Biophysical surveys, Mixed qualitative and/or quantitative methods, Other methods

E. **Nature of data:** Perception-dominant data (participants are asked directly about their opinions), Observation-dominant data (impacts on participants are revealed from the data that are elicited on the target population), Both

F. **Comparator:** Before and after exposure, With and without exposure, Both, None

IV. Exposure and Population:

A. Country: Bangladesh, India, Nepal, Pakistan, Sri Lanka

B. Ecoregion:

C. Exact location of study: Where possible note the exact district and state of study

D. Main purpose of trees on farms: Fruit sale or consumption, Sawnwood, Pulpwood, Fuelwood, Multiple, Latex and/or rubberwood, Resin, Carbon credits, N/A

E. Additional incentive for planting trees in this location other than market demand for materials or services from plantation: Government promotion; tax exemptions, subsidies, policies, promotion, Industry hub, Multiple incentives, N/A

F. Additional information regarding the additional incentive, if available

G. Characterization of the tree plantation area under study

H. Exact/ Average Area of ToF in acres: Numeric input

I. **Exact/ Average Area of ToF in acres:** Numeric input

J. Formal tenure regime: Private, Community-held, Public-private ownership, Unclear, Mixed, N/A

K. Time since the first trees were planted at the time of the study: < 5 years, 5 - 15 years, 15 - 25 years, 25 - 35 years, 35 - 45 years, 45 - 55 years, > 55 years, Mixed, trees already existed, N/A

L. Third party certifications for trees planted/ existing: Certified, Uncertified, Unclear, N/A

M. Work related to trees is conducted: Manually, Mechanically, Both, N/A

N. Number of different tree species planted/ existing: <5, 5-10, 11-15, 16-20, 21-25, >25, N/A

O. **Number of trees planted/existing per hectare:** <5, 5-10, 11-15, 16-20, 21-25, 26-30, 31-35, 36-40, 41-50, >50, N/A

P. Primary species planted/existing; common name for genus if species not specified; if not in the list, WRITE:

Q. Secondary species planted/existing; common name for genus if species not specified; if not in the list, WRITE

R. Tertiary species planted/existing; common name for genus if species not specified; if not in the list, WRITE

S. Other species planted/existing; common name for genus if species not specified; if not in the list, WRITE

T. Integration of local livelihoods where trees planted/exist: No integration, Farming, Grazing, Beekeeping, Collection of fuelwood and/or edibles from the trees practiced, Multiple uses of the plantation, N/A

U. Current land use where trees planted/ exist: Agriculture, Grazing, Mining or drilling, Planted forests, Natural forests or shrubs, Mixed human activities, Mixed human activities and natural forests or shrubs, N/A

V. **Characterization**: Household, Individual farmers, community, Unclear, N/A

V. Outcomes

a. Impact category: Material and living standards related, Health related, Education related, Work and Leisure related, Agency and Political voice related, Social relationships related, Physical and Economic security related.

b. Specific impact (multiple columns): See list of indicators (column 2) in Table 2 - each indicator will have a column

c. Characterization of the impact as stated by the authors: Positive, Negative, Mixed, Neutral, Unreported, Unmet

d. Gender-disaggregated impacts: Yes, No, Unknown, NA

e. Ethnicity-disaggregated impacts: Yes, No, Unknown, NA

f. Notes, if any

VI. Quality of study

a. Key results and conclusions are logically derived and supported by the data and methods: Yes/ No

b. Confounding factors that could have influenced the validity of data and methods are considered: Yes/ No

c. A clear and appropriate comparator is present: Yes/ No

d. Key terms and concepts are clear, replicable and reliable: Yes/ No

e. Data collection methods are clear, replicable and reliable: Yes/ No

f. Sampling selection is explained: Yes/ No

g. Sampling selection is justified: Yes/ No

h. Data analysis methods are clear, replicable and reliable: Yes/ No

i. Key conclusions and recommendations are logically derived and supported by the results: Yes/ No

j. Notes, if any