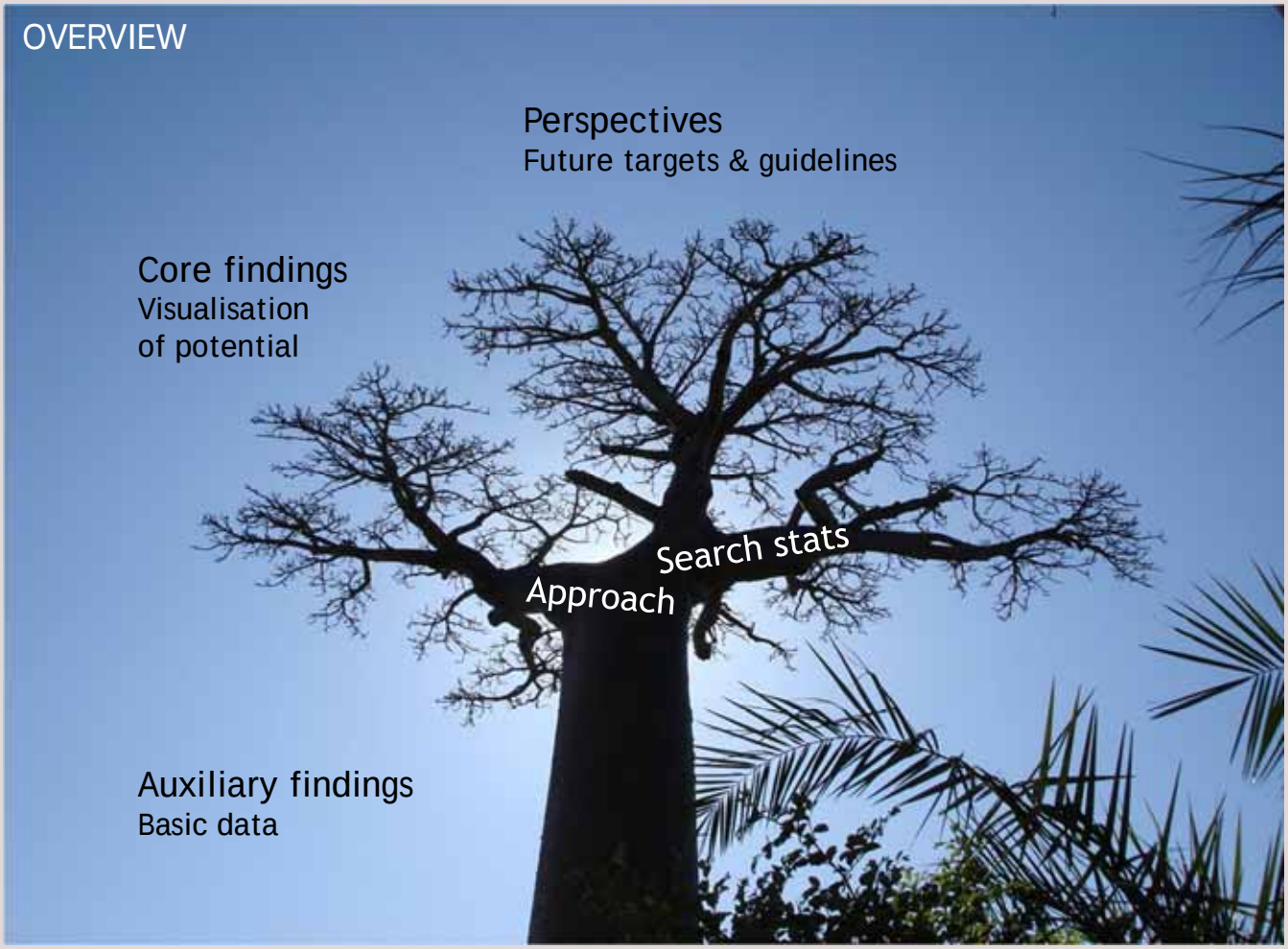
What would happen if we cut all trees?

A systematic mapping of the literature on interactions between socio-economic traits, forest traits and human well-being

by Nele Schmitz

2014-2015



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Contents

Acknowledgements

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Rationale

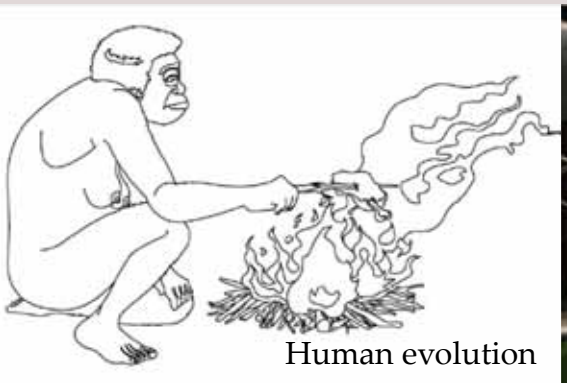
As a wood anatomist, all my attention went the last so many years to the intriguing structure of trees. One day I started pondering on the always dramatically presented deforestation, in contrast to the plantation actions popping up like mushrooms around the world, always presented as Santa Claus gifts. Do we still value the gifts the day after or do they end up on *e*-bay? What would happen if we cut all trees?

Our **knowledge about trees and forests is extensive** as they have been important for humans since early times and still are. This was nicely demonstrated by a recent uproar caused by an article in the New York Times by a professor in atmospheric chemistry "To save the planet, don't plant trees" (NYT Sept. 19, 2014). Three days later all statements were rebutted by a science collective (NYT Sept. 22, 2014).

To illustrate the **importance of trees**, go back in time and think about the wood we used to keep ourselves warm, protected from wild animals and to cook our food. The industrial revolution was sparked by deforestation in the UK and wood (imported) was still needed to drive the steam engines. Did you know that Japan became so technologically advanced because of the continued use of wooden machines, which needed faster replacement and hence allowed more experimenting (Clancey, 2007)! All our means of transport started in wood, without wood no Beagle, we would all be creationists! Especially for scientists, how would our profession have looked like if there were no means to share our knowledge except from having a conversation? Think also about past societies that died out because of deforestation (Diamond, 2005). This relates to the list of ecological functions fulfilled and other services delivered by forests (Ninan & Inoue, 2013). Natural capital in general has a significant impact on life satisfaction (Vermuri & Costanza, 2006; Mulder *et al*., 2006). The Ebola outbreak during the set-up of this study was another (possible) sad illustration of the strong link between people and trees. Fruit bats as carrier of the virus came more into contact with people as before because of deforestation and an increasing mining industry, making miners travel in bat territory (The Guardian Oct. 3, 2014).

Without trees we would still be living in trees


Ecological functions


Human evolution

First vehicles

So we know already that if we would cut all trees, people's lives would be affected in many ways. What we don't know yet is **which forests to keep** in case we had to choose. What is the effect of the type of forest on human well-being? Is there an effect of how the forest is used? Does it matter if the forest is big or small or how healthy the forest is? How can socio-economy interact with these forest characteristics to optimize well-being?

The aim of this study is to give an overview of what exactly is known about forests in relation to human well-being and socio-economy. The **dream we are working towards** is to know for each location, characterized by different *haves*, *needs* (and *wants*), how much forests we need, of which type and how used to optimize the well-being of all. That is, we also need to understand the interactions between forest traits and socio-economic traits, which both vary in space and time.

In times where the word sustainability is used unsustainably, I want to make a call for sustainability starting with the science itself. Lean science reduces waste of energy, re-uses resources, refreshing them if needed. Show respect for your colleagues' hard work in the past and úse their findings before producing a new stack from scratch. Awake sleeping beauties (Ke *et al*., 2015) and help paving the way to a lean science enterprise optimizing efforts to move forward working hard, smart, together (HST).

To end on a high, let's go for LSD, for Ludic Sustainable Development, and keep on dreaming (even after waking up the sleeping beauties).

Nele Schmitz

Frédéric Back (L'homme qui plantait des arbres, 1987)

Acronyms & Abbreviations

agri	agriculture
cat	category
comm	community
conserv	conservation
ES	ecosystem services
FR	forest resources
GNI	Gross National Income
HDI	Human Development Index
HH income	household income
KW	key word
min.	minimum
mgmt	management
NTFP	non timber forest product
nr	number
PFM	participatory forest management
S Am	South America (in this study used to indicate the whole of the Americas south of the USA)
N Am	North America (in this study used to indicate the part of the Americas north of the USA)
WB	well being

? Question setting

THOUGHT:	What would happen if we cut all trees?
VISION:	How balance the management of socio-economy & forests for the well-being of all?
PROJECT AIM:	Identifying knowledge gaps and currently known interactions between defined socio-economic traits, forest traits & well-being
APPROACH:	A systematic mapping of the literature limited by a set of inclusion criteria

https://forestplanet.wordpress.com/2013/01/08/imagining-a-world-without-trees/

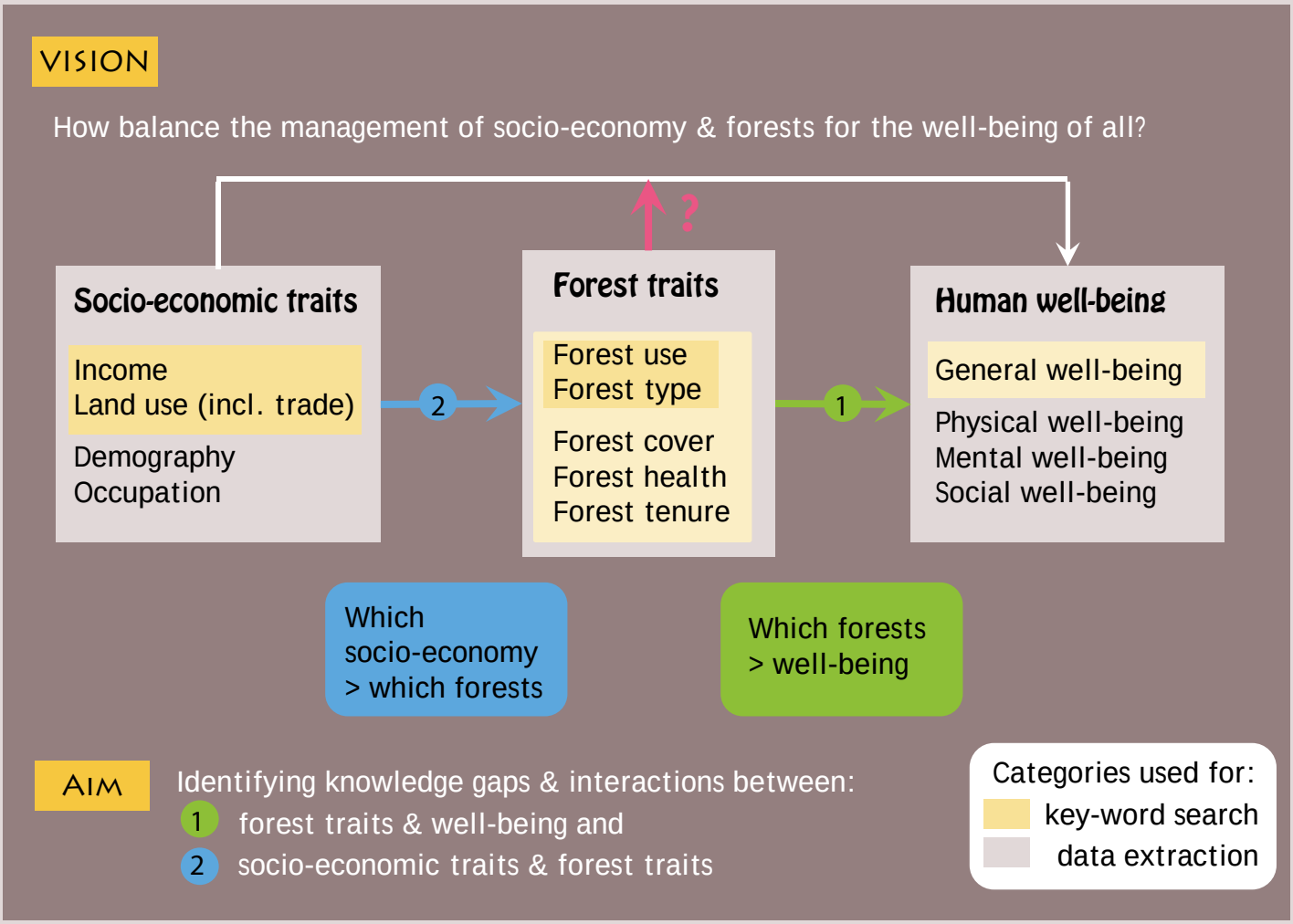
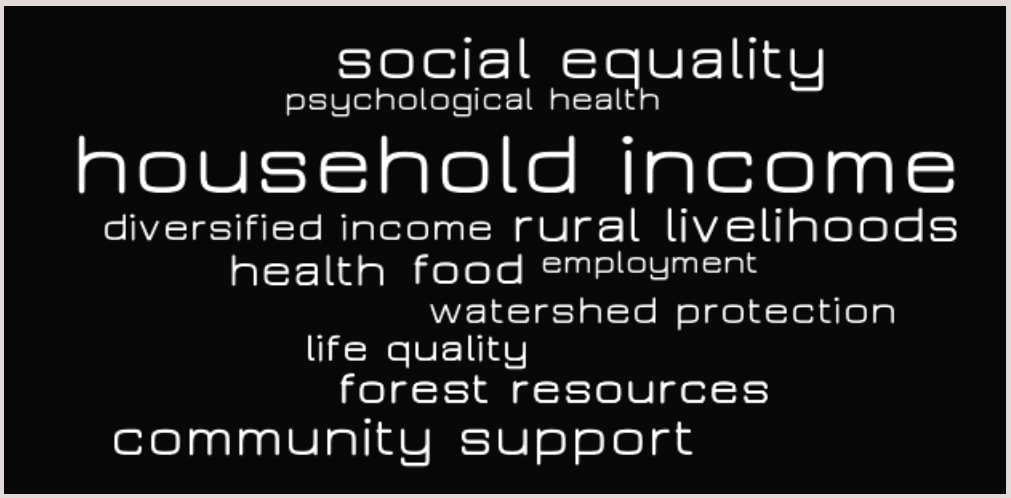


Fig. 1 Scheme illustrating the question setting of the project. Categories used for the key-word searches are indicated in light yellow for review 1 and in yellow for review 2.

What would happen if we cut all trees?

Overview of the positive interactions between socio-economy, forests and well-being, as reported in the literature included in this study. Word clouds are abstract key-words (standardized) of these papers. Min. count is the minimum number of times the words occurred across the papers studied.

These well-being aspects would be affected:



(min. count = 4)

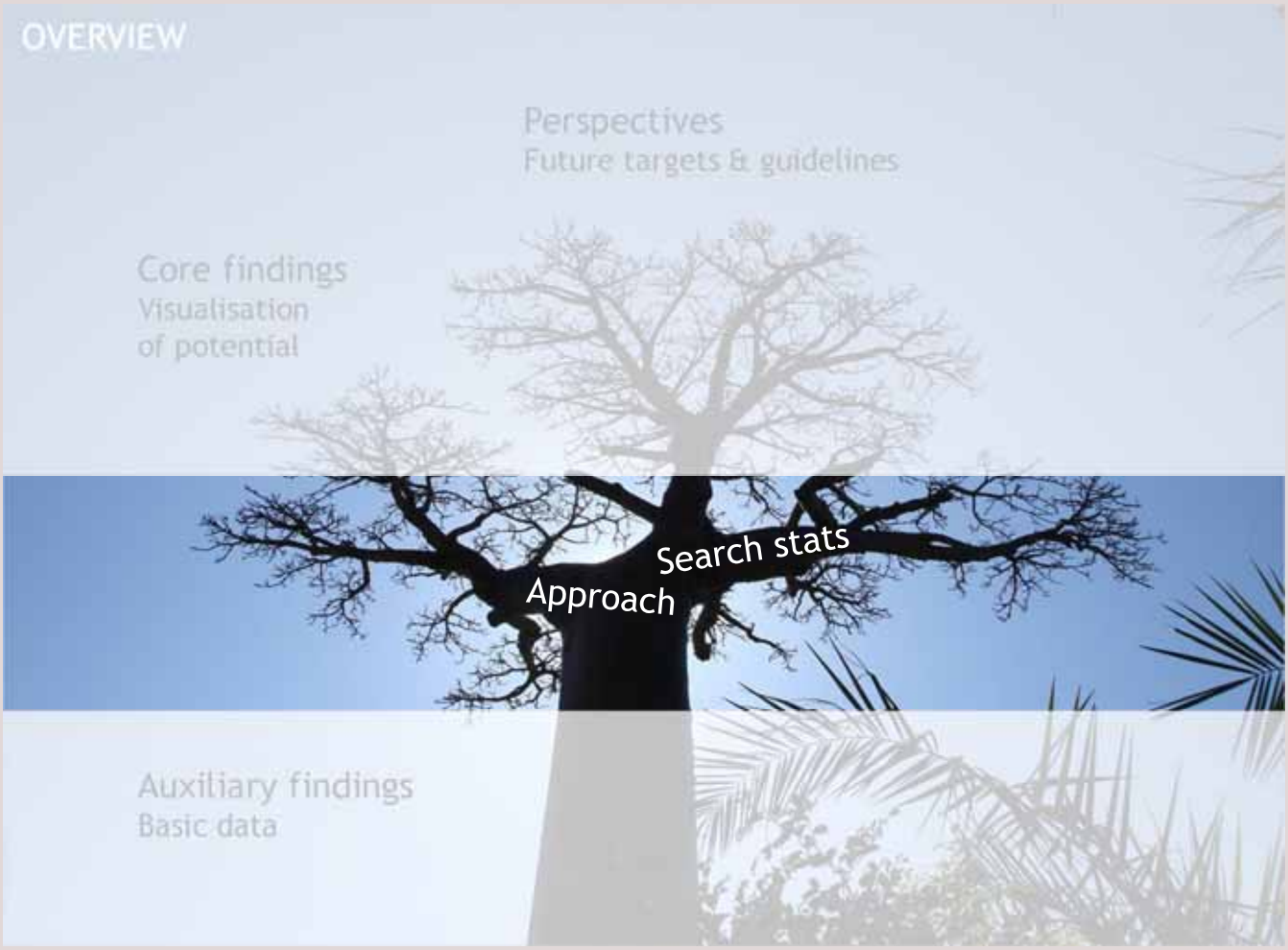
Because they are linked to these forest aspects:

(min. count = 5)

Which are influenced by these socio-economic aspects:

(min. count = 5)

I. Approach


OVERVIEW
Perspectives
Future targets & guidelines
Core findings
Visualisation
of potential
Search stats
Approach
Auxiliary findings
Basic data

Approach

To be able to interprete the study's findings correctly it is important to understand the approach. The project had a duration of only 10 months, limiting the possibilities of the study. I explain these limitations in this chapter to allow a correct interpretation of the findings.

But first, **why a review?** This was well presented in a recent article in *Der Spiegel online* (March 12 2015)*: Studien-Flut. Forscher veröffentlichen zu viel* (A flood of studies. Researchers publish too much). In the article they explain that when an article got published in the seventies, years later it was still being cited well. When you publish an article today, it will have become forgotten already one to a few years later.

That's why I wanted to go digging in that **mass grave of papers**. **Sustainability starts with the science itself**, which should become more lean. Re-use and refresh old ideas, get inspired by their uncontemporary view. New ideas will sprout by itself while wearing out the old ones. Go for a walk in the forest and think about your values in life. Would you like the idea of your own papers never or barely read by anyone? Of course not, so why are we running so hard to publish more and more while taking no or too little time to first explore what is known already? The importance of past research for the present was nicely shown in the recent publication „Defining and identifying Sleeping Beauties in science" (Ke *et al.*, 2015).

Given the loads of information available, a review goes together with a set of **limitations**. This study is a first attempt in the ten months I have available for this project. Therefore I hope this work can be an inspiration for many researchers all over the world. The world is complex, making it so beautifully variable and interesting for all of us, motivated researchers to do our best to understand it. Although I couldn't include this work (for now?), I want to make us realize that there is an entire **parallel universe** of information written in non-English languages.

Suboptimal use of our knowledge



Shaun Tan

Systematic mapping

- Literature review based on abstract only
- Pre-defined key-words, data-extraction categories & inclusion criteria
- Method is adapted from: Randall & James (2007), Moher (2009), CEC (2013), Pickering & Byrne (2014)

Limitations

Search limitations:

- Source: Web of Science Core Collection
- Time scale: 1992 – Feb. 2015
- Spatial scale: global
- Document type: article in English
  (*i.e.* no review, report, conference proceeding, book chapter)
- Pre-defined key-word combinations (Table 1-2) with explicit mentioning of a relation between (i) socio-economy & forests or (ii) forests & well-being

Rio Declaration
incl. the *Forest Principles*, a first global consensus on forests

Review limitations:

- Based on abstract only
- Pre-defined (sub)categories for subject data extraction (Table 3)
- Total data extracted:
  - article reference data (author, title, journal)
  - geographical & time setting (reprint address, study area, publication year)
  - subject (sub)categories studied
  - interaction effect (positive, negative, mixed)
  - socio-economic, forest and well-being key-words (giving the main content of the abstract)

What's in a name

When reviewing abstracts the socio-economic, forest and well-being data are categorized in the pre-defined categories and sub-categories. These must therefore not be interpreted in the strict sense of the word but as a term grouping all words that do not fit in one of the other (sub)categories.

F.ex. The category *demography* contains factors like *education level* and *household age*, but also *knowledge sharing* and *participatory management*.

Literature is searched for in an as exhaustive as possible way by using selected key-words together with their synonyms (Table 1-2). This review will therefore include papers using varied definitions of well-being and forest. Below some explanation about both terms.

Well-being is inherently subjective and hence defined differently by different authors. The constituents of WB, as experienced and perceived by people, are situation-dependent, reflecting local geography, culture, and ecological circumstances (MA, 2005). Economic needs, human needs and environmental needs vary and the degrees to which they are covered determine life quality, which combined with health leads to human WB (Summers *et al.*, 2012; Smith *et al.*, 2013).

Forest can be defined very specifically (FAO, 2010) but also more broadly reflecting the literature used for the study (FAO, 2014). *Forest* in this report hence refers to any group of trees, natural or planted, including urban trees and agroforestry systems. Other woody species like lianas, vines and palms are excluded as we want to focus on the specific goods and services delivered by the growth form tree. We don't exclude on tree size but as we require all papers to have "tree*", "forest*" or "wood*" in the title, all papers specifically talking about shrubs are excluded.

Reminder:
The findings of a review are a representation of the **interests** of the researchers so far, not of the importance of certain traits over others.

There are never enough bricks
and there are too few good synthesizers who
wish to search out the bricks
and thus put the wall together.
These worthy people are usually too busy
working on their own data.

C. Wright Mills (1959)

Search strings

Table 1 Search strings used for the literature search on forests in relation to well-being. Key-words (KWs) related to forest traits and well-being used in the 'Topic' or 'Title' search field, were combined with the operator 'AND'. Each search was combined with (tree* or forest* or wood*) in the 'Title' field.

Search nr.	Forests			Well-being	
	Category	Field	Key-Words	Field	KWs
1	Ftype	Topic	((tree* or forest* or wood*) near/2 (*diversity or richness or abundance))	Topic	A
2	Ftype	Topic	((tree* or forest* or wood*) near/2 (exotic or alien or foreign or introduced))	Topic	A
3	Ftype	Topic	((tree* or forest* or wood*) near/2 (native or indigeneous))	Topic	A
4	Ftype	Topic	((tree* or forest* or wood*) near/2 (*natural or primary or secondary or plantation))	Topic	A
5	Ftype	Topic	((tree* or forest* or wood*) near/2 (gymno* or needle or conifer*))	Topic	A
6	Ftype	Topic	((tree* or forest* or wood*) near/2 (angio* or broadlea* or deciduous))	Topic	A
7	Fuse	Topic	((tree* or forest* or wood*) near/2 ("land-use*" or "land use*"))	Topic	A
8	Fuse	Topic	((tree* or forest* or wood*) near/0 (use* or management))	Topic	A
9	tenure	Topic	((tree* or forest* or wood* or land*) near/2 (owner* or access))	Topic	A
10	tenure	Topic	((tree* or forest* or wood* or land*) near/2 (*right*))	Topic	A
11	tenure	Topic	((tree* or forest* or wood* or land*) near/0 (*owned))	Topic	A
12	tenure	Topic	((tree* or forest* or wood* or land*) near/1 (tenure or tenancy))	Topic	A
13	tenure	Title	owner* or access or right* or *owned or tenure or tenancy	Topic	A
14†	Fhealth	Title	((tree* or forest* or wood*) near/2 (health or resilience))	Topic	A
15†	Fhealth	Topic	((tree* or forest* or wood*) near/0 (health)) or ((tree* or forest* or wood*) near/2 (resilienc*))	Topic	A
15†	Fhealth	Title	NOT ((tree* or forest* or wood*) near/2 (health or resilience))	Topic	A

A (human or public or people or family or societ*) AND (health or "life expectancy" or "life span" or longevity or wellbeing or well-being or welfare or wellness or happiness or prosperity or ((satisfaction or quality) near/1 life)) NOT° (health near/0 (animal or tree or ecosystem or forest or environment* or soil or landscape))

° For search nr. 1 this exclusion was not applied; † For these searches the well-being KWs for the NOT-string were reduced to: (health near/0 (animal or soil))

Key-words were chosen to integrate (i) important forest traits that can influence WB and (ii) major characteristics of socio-economy that can influence forests. For the WB part we used the key-words *WB* and a list of synonyms in addition to *health* as a component of WB (Smith *et al*., 2013). For the socio-economic part we focused on the effects of foreign land use (and thus trade) and the effects of income on forest characteristics. These choices can be justified by the global megatrends of "From a unipolar to a multipolar world" and "Increasing global divergence in population trends" (EEA, 2011). A list of synonyms of *trade* and *income (inequality)* were used as key-words.

Table 2 Search strings used for the literature search on socio-economy in relation to forests. Key-words (KWs) related to socio-economic traits and forest traits, used in the 'Topic' or 'Title' search field, were combined with the operator 'AND'.

Search nr.	Socio-economy			Forests		
	Category	Field	KWs	Category	Field	Key-Words
1	trade	Topic	A	Fuse	Topic	((tree* or forest* or wood*) near/2 ("land-use*" or "land use*"))
2		Topic	A		Topic	((tree* or forest* or wood*) near/0 (use* or management))
3		Topic	A	Ftype	Topic	((tree* or forest* or wood*) near/2 (*diversity or richness or abundance))
4		Topic	A		Topic	((tree* or forest* or wood*) near/2 (exotic or alien or foreign or introduced))
5		Topic	A		Topic	((tree* or forest* or wood*) near/2 (native or indigeneous))
6		Topic	A		Topic	((tree* or forest* or wood*) near/2 (*natural or primary or secondary or plantation))
7		Topic	B°	Fuse	Topic	((tree* or forest* or wood*) near/2 ("land-use*" or "land use*"))
8		Title	B		Topic	((tree* or forest* or wood*) near/0 (use* or management))
9		Topic	B		Title	((tree* or forest* or wood*) near/0 (use* or management))
10		Title	B	Ftype	Topic	((tree* or forest* or wood*) near/2 (*diversity or richness or abundance))
11		Title	B		Topic	((tree* or forest* or wood*) near/2 (exotic or alien or foreign or introduced))
12		Title	B		Topic	((tree* or forest* or wood*) near/2 (native or indigeneous))
13		Title	B		Topic	((tree* or forest* or wood*) near/2 (*natural or primary or secondary or plantation))
14		Topic	•	Fuse	Topic	((tree* or forest* or wood*) near/2 ("land-use*" or "land use*"))
15		Topic	•	Fuse	Topic	((tree* or forest* or wood*) near/0 (use* or management))
16		Topic	•	Ftype	Topic	((tree* or forest* or wood*) near/2 (*natural or primary or secondary or plantation))
17	income	Topic	C†	Fuse	Topic	((tree* or forest* or wood*) near/2 ("land-use*" or "land use*"))
18		Title	C		Topic	((tree* or forest* or wood*) near/0 (use* or management))
19		Title	C‡	Ftype	Topic	((tree* or forest* or wood*) near/2 (*diversity or richness or abundance))
20		Topic	C		Topic	((tree* or forest* or wood*) near/2 (exotic or alien or foreign or introduced))
21		Topic	C		Topic	((tree* or forest* or wood*) near/2 (native or indigeneous))
22		Title	C		Topic	((tree* or forest* or wood*) near/2 (*natural or primary or secondary or plantation))

23	Topic	D	Fuse	Topic	((tree* or forest* or wood*) near/2 ("land-use*" or "land use*"))
24	Title	D		Topic	((tree* or forest* or wood*) near/0 (use* or management))
25	Title	D‡		Title	((tree* or forest* or wood*) near/0 (use* or management))
26	Topic	D	Ftype	Topic	((tree* or forest* or wood*) near/2 (*diversity or richness or abundance))
27	Topic	D		Topic	((tree* or forest* or wood*) near/2 (exotic or alien or foreign or introduced))
28	Topic	D		Topic	((tree* or forest* or wood*) near/2 (native or indigeneous))
29	Title	D		Topic	((tree* or forest* or wood*) near/2 (*natural or primary or secondary or plantation))

A (international* near/1 (trade* or supply)) or (land near/1 (displacement or footprint or foreign or grab*))

B (trade* or import or export) NOT ("trade-off*" or tradeoffs or (nitrogen or nutrient or phosphor*))

• (foreign near/0 (invest* or "deals of land" or production)) or ("resource extraction" AND (foreign or trade or national* or opportunistic or elsewhere)) or (land near/0 (lease or concession or sales or "use accounting" or acquisition or appropriation))

C poverty or inequality or "income gap" or "income distribution" or "income disparity"

D (national or family or household)) OR ((livelihood or wealth) near/1 (status or level or standard or distribution))

° B completed with (tree* or forest* or wood*) in the 'Title field' and the NOT-string was adapted with 'export near/2' (nitrogen or nutrient or phosphor*)

• To make sure search strings A and B were not too restrictive, all forest search strings were combined with this extra search string of KWs related to trade. Only for the search strings mentioned, articles were found.

† Search string C was adapted with "disparity" instead of "income disparity"

‡ Simplification of search string C to (poverty or inequality or income) and D to (socio-economic* or socioeconomic*)

Data extraction categories

Table 3 Pre-defined (sub)categories used for data-extraction from the abstracts of the papers identified in the systematic mapping. Categories used for the searches (Table 1,2) are indicated in light yellow (🟢) and yellow (🔵) (see Fig. 1).

Socio-economy		Forests		Well-being
Category	Subcategory	Category	Subcategory	Category
income	income	Fuse	forestry for profit	general
land use	land use		forestry subsistence	physical
	trade		forest recreation	mental
demography	demography		forest reserve	social
	Pdensity		urban trees	
	politics	Ftype	diversity	
	education		authenticity	
occupation	Otype	Fhealth	Fhealth	
	innovation	tenure	private	
			state	
			communal	
			access	
			mixed	
		Fcover	cover	

Fcover, forest cover; Fhealth, forest health; Ftype, forest type; Fuse, forest use; Otype, occupation type; Pdensity, population density.

Table 4 Habitat type (adapted from WWF), assigned to each paper by making use of a global biome map illustrating the different habitat types per biome (CIESIN, 2012). Biomes were regrouped to present the drier and the wetter regions.

Biome	Habitat type	Climate	
		Moist	Dry
Tropical	Tropical and Subtropical Moist Broadleaf Forests	MOIST	
Tropical	Tropical & Subtropical Dry Broadleaf Forests		DRY
Tropical	Tropical & Suptropical Coniferous Forests	MOIST	
Tropical	Tropical & Subtropical Grasslands, Savannas & Shrublands		DRY
Tropical	Flooded Grasslands & Savannas	MOIST	
Temperate	Temperate Broadleaf & Mixed Forests	MOIST	
Temperate	Temperate Coniferous Forests	MOIST	
Temperate	Temperate Grasslands, Savannas & Shrublands		DRY
Polar/montane	Boreal Forests / Taiga		
Polar/montane	Montane Grasslands & Shrublands		
Polar/montane	Tundra		
Dry	Mediterranean Forests, Woodlands & Scrub		DRY
Dry	Deserts & Xeric Shrublands		DRY
Urban	Urban trees		
Mixed	Mixed		

Mixed, studies on an area covering multiple biomes.

DATA ANALYSIS

Data added afterwards

- **Habitat type:** this was done using the research area mentioned in the abstract (this info was lacking only a few times, when the full article was consulted) and a global biome map (CIESIN, 2012) showing the 14 major habitat types according to WWF (Table 4).

For the studies on one country for which data were available:

- **GNI**: Countries were grouped in low-, middle- and high-income economies according to the GNI per capita, calculated using the World Bank Atlas method.
- **Gini index:** Countries were grouped in low (0-39), medium (40-49) and high (50-100) Gini index classes. The Gini index measures the extent to which the distribution of income or consumption expenditure among individuals or households within an economy deviates from a perfectly equal distribution.
- **HDI:** Countries were grouped in one of three classes of Human Development Index ranks in 2013 (from the 2014 Human Development Statistical Tables), that is 1-20, 21-100 or >100. Rank 1 corresponds to the highest HDI.

Data sources used

WWF major habitat types
http://wwf.panda.org/about_our_earth/ecoregions/about/habitat_types/selecting_terrestrial_ecoregions/

GNI http://data.worldbank.org/about/country-and-lending-groups

Gini index http://data.worldbank.org/indicator/SI.POV.GINI

HDI ranks http://hdr.undp.org/en/data

Table 5 Number of papers on countries for which data were available for GNI, GINI and HDI in comparison to the total number of papers identified for the different subjects of the systematic mapping.

Subject	Nr. of papers			
	Total	GNI	GINI	HDI
Forests *vs.* well-being	112	94	76	99
Socio-economy *vs.* forests	193	151	130	169

Word clouds

Output key-words were unified (to remove synonyms) and simplified (to generalize and keep the key message) before making word-clouds.

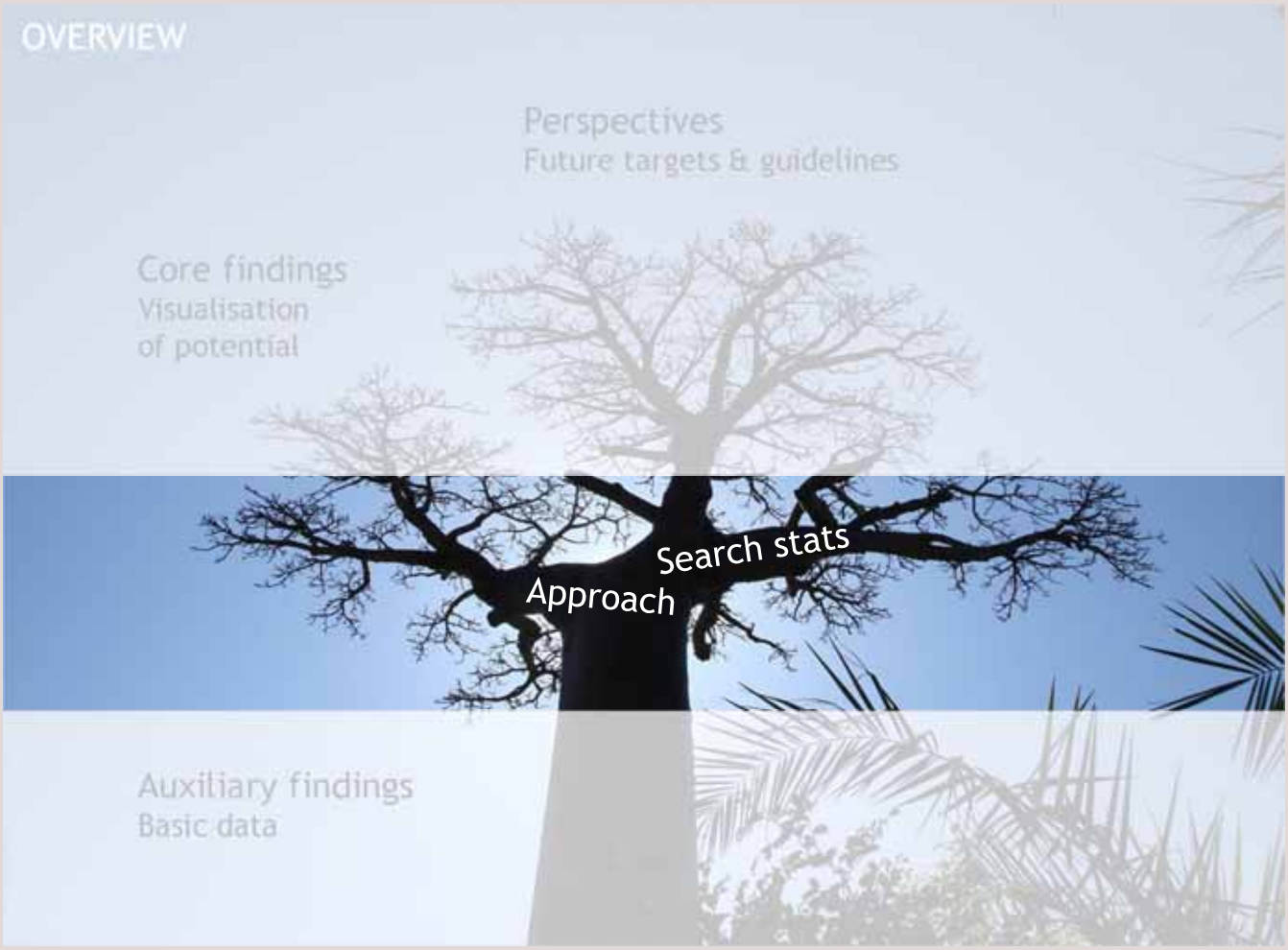
Word clouds were made using the online software *WordItOut*. The size of the words represents the frequency the words occur in the data extraction table.

WordItOut http://worditout.com/word-cloud/make-a-new-one

Duplicates?

As the content of papers can fit into different (sub)categories, duplicate entrances of the paper were removed for each analysis done on a level that didn't deal with the (sub)category that justified the paper to be mentioned more than once.

II. Search statistics



Search statistics

Overall search

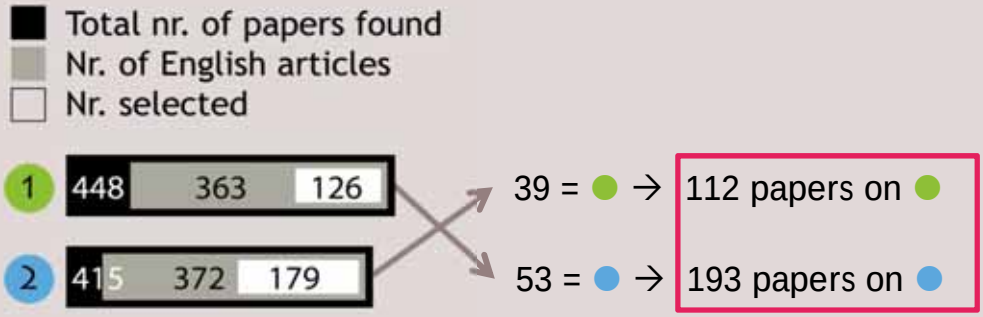


Fig. 2 Total number of papers identified when searching on forests in relation to socio-economy (●) or well-being (●), after filtering for english articles and after reviewing abstracts. As some papers on socio-economy were found during the well-being search and vice versa, the total number of papers per topic is given as well.

Individual searches

Table 6 Number of papers found when browsing literature for the effect of forest traits on well-being. All included papers do not sum up to 112 as mentioned above because of duplicates among the searches. For the search strings used, linked to search nr., see Table 1.

Search nr.	Number of papers					% of papers	
	Total	English	Article	Engl. art.	Included	English	Article
1	54	52	47	45	12	96	87
2	12	12	12	12	3	100	100
3	12	11	11	10	5	92	92
4	58	53	52	47	17	91	90
5	11	10	11	10	4	91	100
6	27	26	25	24	7	96	93
7	11	11	10	10	8	100	91
8	99	92	89	82	49	93	90
9	36	32	32	28	19	89	89
10	8	8	5	5	2	100	63
11	4	3	3	3	1	75	75
12	8	8	8	8	7	100	100
13	10	10	8	8	2	100	80
14	44	41	32	29	5	93	73
15	54	52	44	42	21	96	81

Table 7 Number of papers found when browsing literature for the effect of socio-economic traits on forest traits. All included papers do not sum up to 193 as mentioned above because of duplicates among the searches. For the search strings used, linked to search nr., see Table 2.

Search	Number of papers					% of papers	
nr.	Total	English	Article	Engl. art.	Included	English	Article
1	8	8	7	7	5	100	88
2	16	16	15	15	9	100	94
3	10	10	9	9	8	100	90
4	15	14	14	13	9	93	93
5	13	13	9	9	7	100	69
6	24	23	20	19	11	96	83
7	22	22	21	21	12	100	95
8	20	20	19	19	13	100	95
9	30	29	28	27	5	97	93
10	10	10	10	10	4	100	100
11	7	6	6	5	2	86	86
12	13	12	12	11	3	92	92
13	24	24	23	23	13	100	96
14	9	9	9	9	4	100	100
15	25	25	23	23	5	100	92
16	4	4	3	3	2	100	75
17	32	31	31	30	16	97	97
18	13	13	12	12	10	100	92
19	13	13	13	13	7	100	100
20	15	14	15	14	3	93	100
21	14	10	12	8	5	71	86
22	14	14	11	11	8	100	79
23	12	11	12	11	7	92	100
24	4	4	4	4	2	100	100
25	6	6	5	5	4	100	83
26	29	28	29	28	23	97	100
27	5	5	5	5	4	100	100
28	4	4	4	4	4	100	100
29	4	4	4	4	1	100	100

Temporal distribution of the research

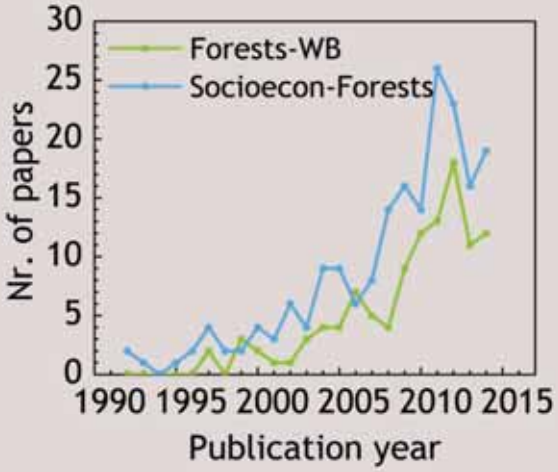


Fig. 3 Cumulative number of papers on forests, socio-economy and well-being from 1992-2014.

The peaks in publication numbers in 2011-'12 can be explained by the release of the *Global Forest Resources Assessment* in 2010 (previous one dated from 2005) and by the declaration of the United Nations of 2011 as the *International Year of Forests.*

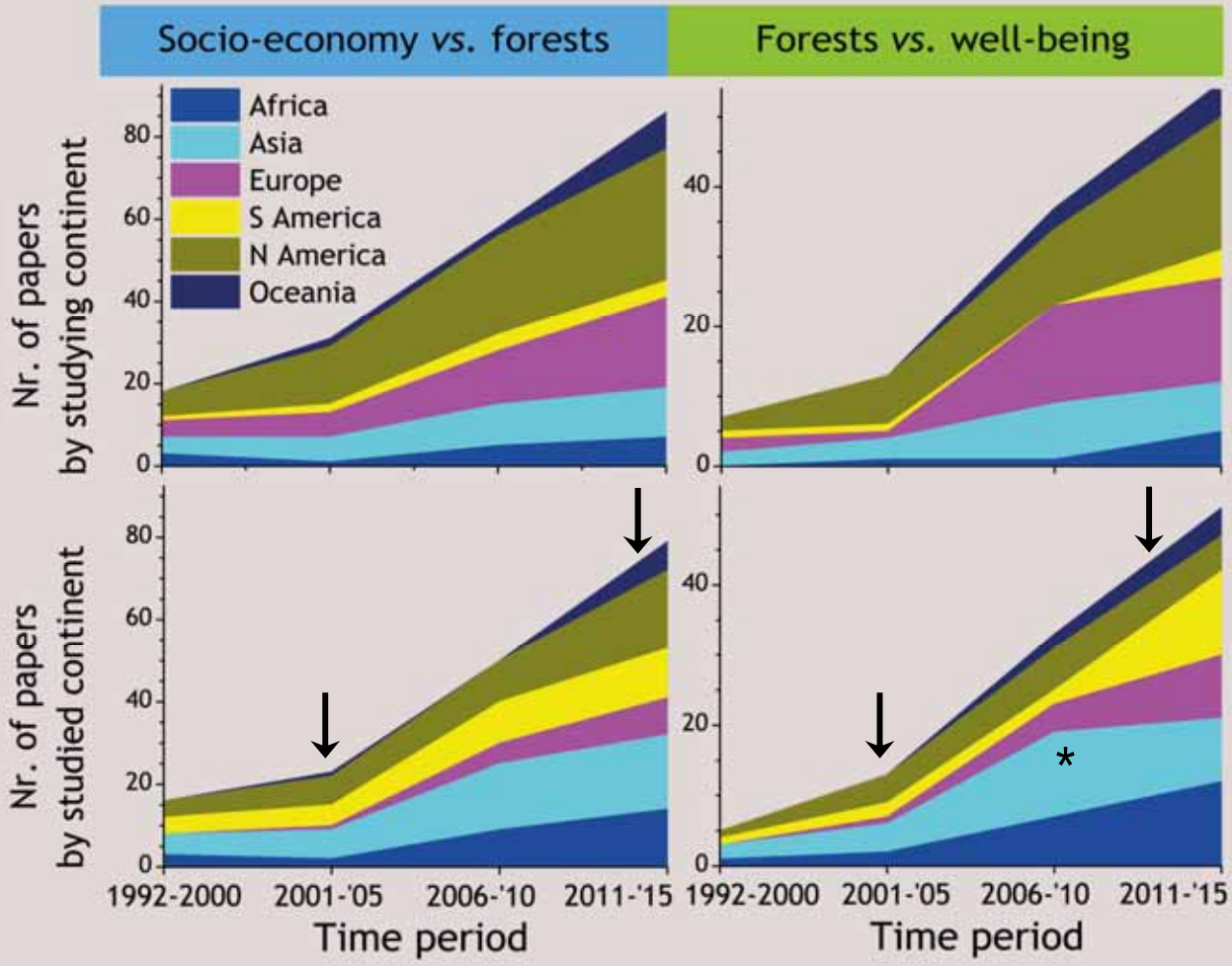


Fig. 4 Evolution of the research on forests in relation to socio-economy (●) or well-being (●) per continent doing the study and being studied. Values are number of papers found by the systematic mapping.

The number of studies on the interactions between socio-economy, forests and well-being shows a continuous increase for all continents, with one exception for Asia (*).

North America has been the major studying continent throughout and Asia the main studied continent. However there is an evolution from studies mainly in the Americas and Asia to also including Africa and Europe (arrows).

Spatial distribution of the research

Table 8 Number of papers identified by the systematic mapping for the different continents doing the studies and being studied.

Studying continent		Studied continent					
		S Am	Africa	Oce	Asia	Eur	N Am
Forest traits *vs.* well-being							
S America	6	6	0	0	0	0	0
Africa	7	0	7	0	0	0	0
Oceania	8	1	0	5	2	0	0
Asia	20	1	0	0	19	0	0
Europe	32	1	7	0	4	14	0
N America	39	8	8	1	2	0	16
Total	**112**	**17**	**22**	**6**	**27**	**14**	**16**
Socio-economic traits *vs.* forest traits							
S America	11	11	0	0	0	0	0
Africa	16	0	16	0	0	0	0
Oceania	13	2	0	6	2	0	3
Asia	32	4	0	0	26	0	0
Europe	45	4	5	0	8	15	1
N America	76	10	7	2	10	0	36
Total	**193**	**31**	**28**	**8**	**46**	**15**	**40**

The data below show a high nr. of researchers in Asia that can explain the high nr. of studies, although it is not in proportion to the amount of forest area in the region. The data also explain the low nr. of studies for Oceania but not for Europe. Publishing language is the most likely explanation as it is for the low number of studies done by South America. The data below are based on Thomson Reuters' Science Citation Index and hence don't include papers published in local journals.

Europe & North America show the weakest link between studying and studied continent(s), most likely linked to opportunity to study and travel, and to foreign land use.

Table 9 World distribution of publications, researchers (UNESCO, 2010) and forest area (FAO, 2010).

Continent	World share of publications (%)	World share of researchers (%)	World share of forest area (%)
Africa	2.0	2.2	17.0
Oceania	3.4	2.0	5.0
S Am	4.9	3.5	21.0
Asia	30.7	**40.9**	15.0
N Am	31.1	21.9	17.0
Europe	**42.5**	29.5	**25.0**

Most studied countries for forests in relation to socio-economy (🔵) or well-being (🟢). Countries shown were subject of min. 3 papers.

Box. 1 The language gap

Although English is the main language used for scientific publications, the importance of national language journals for knowledge exchange should not be underestimated. The findings of a study analysing all publications of the *Pubmed* database between 1965 en 2005 showed that in Germany, France and Russia still 19%, 60% and 98% of the papers, respectively were published in 2005 in the local language (Biglu & Umstätter, 2007).

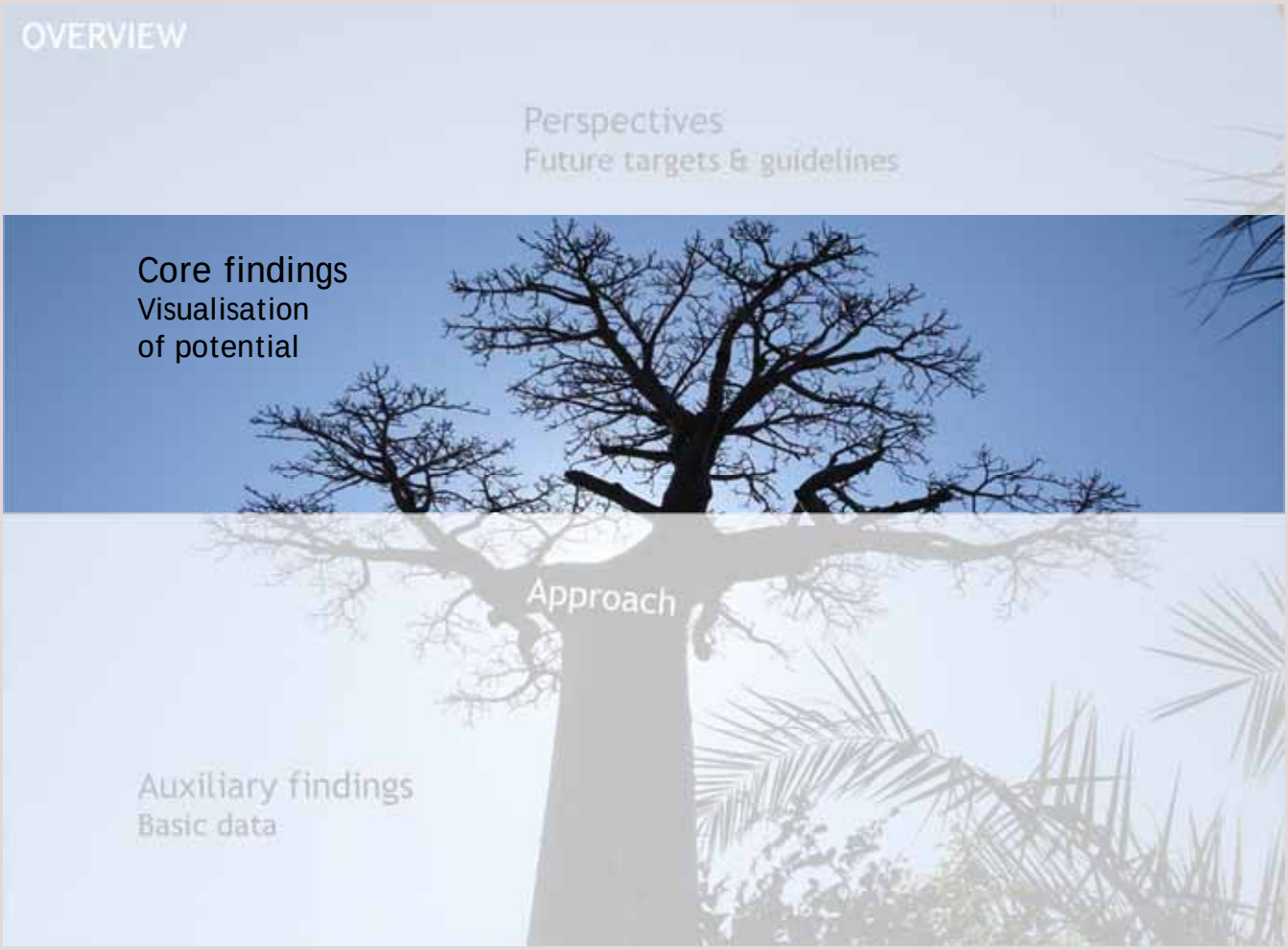
On top of that, the use of English as a publication language for multidisplinary studies might be less pronounced than f.ex. the pure natural sciences. Journals not published in English or with a specialised focus are also more likely to be suppressed and stripped of their impact factor because of abundant journal self-citations (Krell, 2014).

Our knowledge base will thus be biased towards the topics dealt with in English language journals. In this case of forests in relation to socio-economy and well-being, the low number of papers on European forests relative to their world share might be related to a significant amount of papers written in a local language. Also the little amount of studies executed by South America might be explained by non-English publications, next to the low world share of researchers.

To solve the language bias, I have an idea:

we could set-up a *research dating site* to form teams of researchers working on similar topics but speaking/understanding different languages. In this way research could be performed immediately capturing the entire knowledge available on a topic ánd integrating different world views (created by climate, vegetation, religion, economical situation, politics, ...), related to different needs and wants of people.

III. Core findings



Research bias

Distribution of topics studied: bias towards forest use

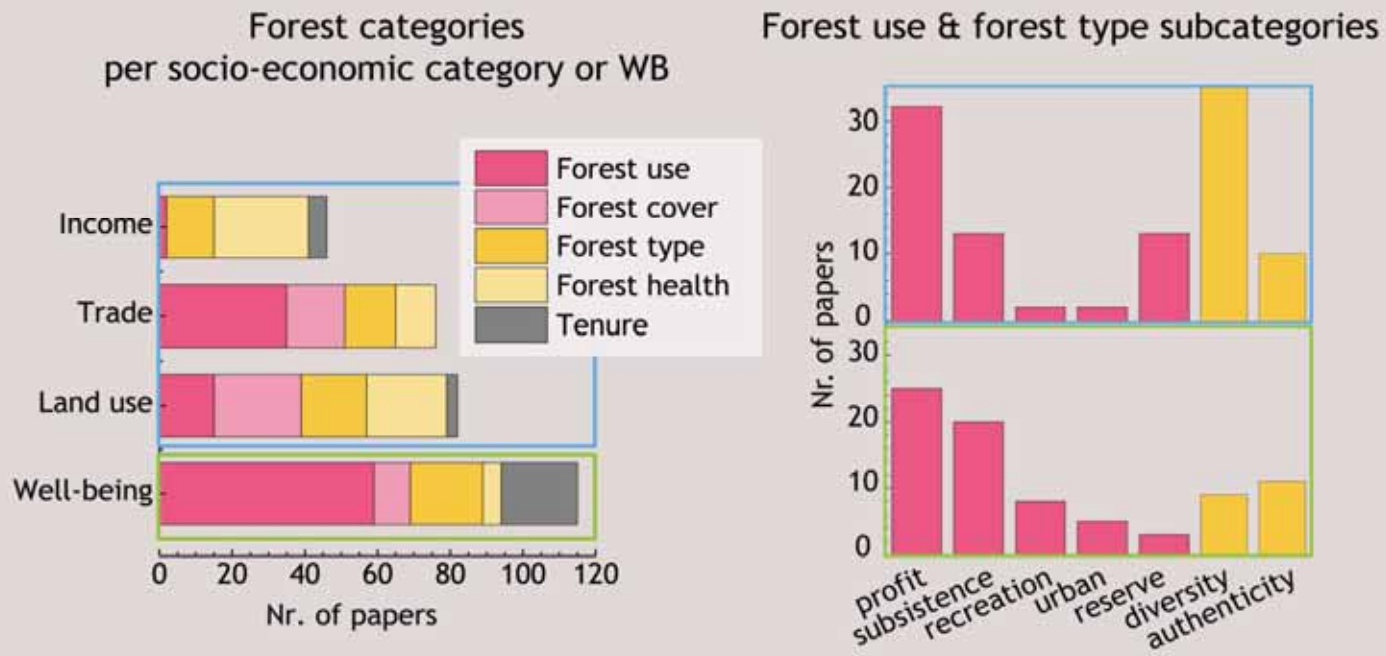


Fig. 5 A. The distribution of forest traits studied so far in relation to (i) the socio-economic traits searched on during the systematic mapping and (ii) well-being. F, forest. **B.** More detailed distribution of the studied forest traits within the category „forest use“ and „forest type“. A priori subcategories were: forestry for profit, subsistence forestry, forest recreation, urban trees, forest reserves (forest use) and species diversity and authenticity, that is native as opposed to exotic species (forest type).

CASH FOREST

Up to now research was clearly concentrated on different **forest uses** and their effect on well-being, rather than on the type or health of the forest or its ownership. Especially, the effects of forests used for profit or subsistence have highly been studied. Knowing that in developing countries (see Fig. 8A) environmental income accounts for 28% of total household income, 77% of which comes from natural forests, this finding is not surprising (Angelsen *et al.*, 2014). However, with changing environmental conditions also wood anatomy and species composition is expected to change, which will affect wood quality and hence functionality. The little research done so far on the effect of forest type on well-being should incite action.

Continents studied: bias towards Asia

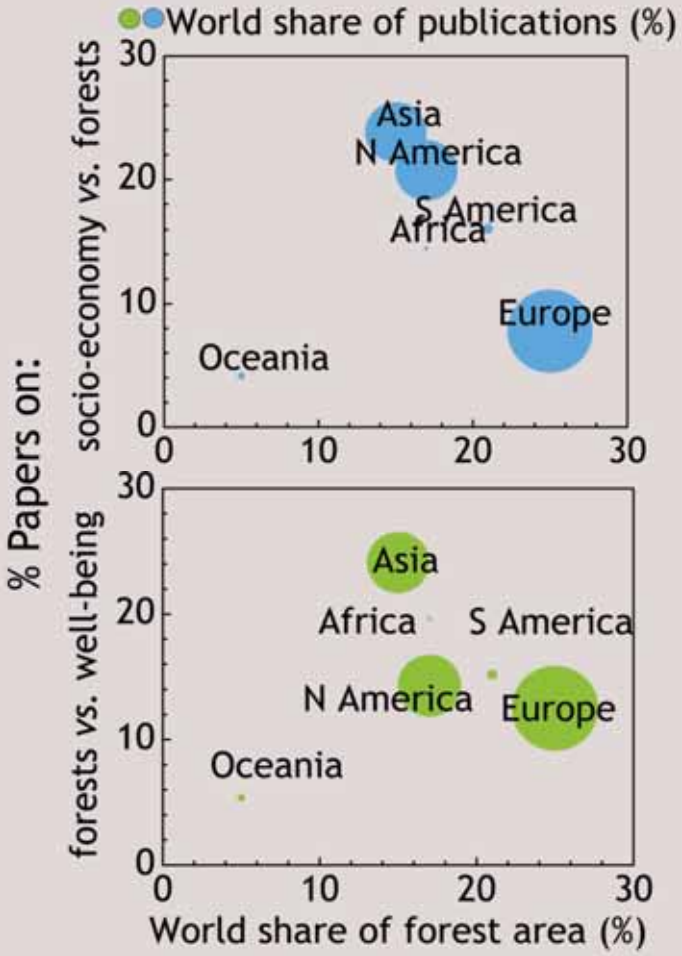


Fig. 6 The proportion of papers identified on forests in relation to socio-economy (●) or well-being (●) studied on different continents in relation to their world share of forests and publications (bubble size). Data from: UNESCO (2010) using data from 2007-2008 and FAO (2010).

GEOGRAPHIC DISEQUILIBRIUM

Our knowledge about forests in relation to socio-economy or well-being is strongly biased towards forests in Asia, while its world share in forest area is only moderate.

Relative to their world share of publications, Africa & South America have been studied a lot on our topic. This is however due to the high amount of studies performed by foreigners (Table 8).

The opposite is true for Europe which is most likely due to a language gap (see Box 1).

ⓘ Box. 2 Talking stick

An instrument of aboriginal democracy used by many tribes, especially those of indigenous peoples of the Northwest Coast of North America. The talking stick may be passed around a group or used only by leaders as a symbol of their authority and right to speak in public. In a tribal council circle, a talking stick is passed around from member to member allowing only the person holding the stick to speak [Wikipedia, consulted June 1 2015].

The talking stick doesn't seem to work for research on forests in relation to socio-economy and well-being. The continents with most "sticks" (forests), Europe & South America, have only little studies done on the topic relative to the other continents (remember: that is, studies published in English and fulfilling our inclusion criteria).

Spatial distribution of the research over time: research done haphazardly

Table 10 Available information per time period and per continent about the effect of: **A.** forest traits on well-being and **B.** socio-economic traits on forest traits. Values are number of papers found by the systematic mapping. Only the main continent studied per time period and study trait is given.

A

Forest traits	Time period & Main continent studied							
	'92-'00	Continent	'01-'05	Continent	'06-'10	Continent	'11-'15	Continent
FCOVER	2	Asia&S Am	2	Asia&N Am	2	Africa & Oc	4	S Am
FUSE	4	Mix	8	Asia	17	Asia	32	N Am&Eur
FTYPE	1	W	2	S Am	6	Asia	11	S Am
FHEALTH	0	-	0	-	1	Europa	4	Africa&Asia
TENURE	0	-	1	N Am	15	Asia	5	Africa&S Am
Well-being								
GENERAL	6	Asia	10	Asia	24	Asia	34	Africa
PHYSICAL	1	-*	3	N Am	10	Mix	15	N Am&Eur
SOCIAL	0	-	0	-	2	Asia	2	S Am&Eur
MENTAL	0	-	1	Africa	5	W&N Am	5	W

B

Socio-economic	Time period & Main continent studied							
	'92-'00	Continent	'01-'05	Continent	'06-'10	Continent	'11-'15	Continent
DEMOGRAPHY	5	Asia&N Am	5	N&S Am	11	Asia	16	Mix
INCOME	6	Africa	1	Asia	16	Africa	21	Asia
OCCUPATION	0	-	1	Africa	4	Asia	1	N Am
LAND USE	11	S Am	27	Asia	39	S Am	58	N Am
Forest traits								
FCOVER	10	Asia	10	Asia&W	22	Asia	24	Asia
FUSE	5	Africa&W	14	Asia	16	Asia	25	Asia&S Am
FTYPE	5	S Am	5	W	12	Africa	21	S Am&Africa
FHEALTH	1	N Am	8	N Am	10	N Am	23	N Am
TENURE	1	Asia	2	N Am	4	N Am&W	2	N Am&Africa

Eur, Europe; N Am, North America; Oc, Oceania; S Am, South America; W, world. *World* indicates papers studying more than one continent.

* lab study on wood preservatives

Over the years the interest in forest effects on well-being and socio-economic effects on forests increased. However, also the continents and specific topics studied changed leading to an unsystematic increase of our knowledge.

Only for the topics indicated in colour our understanding grew systematically over time for specific continents.

Biomes studied: bias towards (sub)tropics

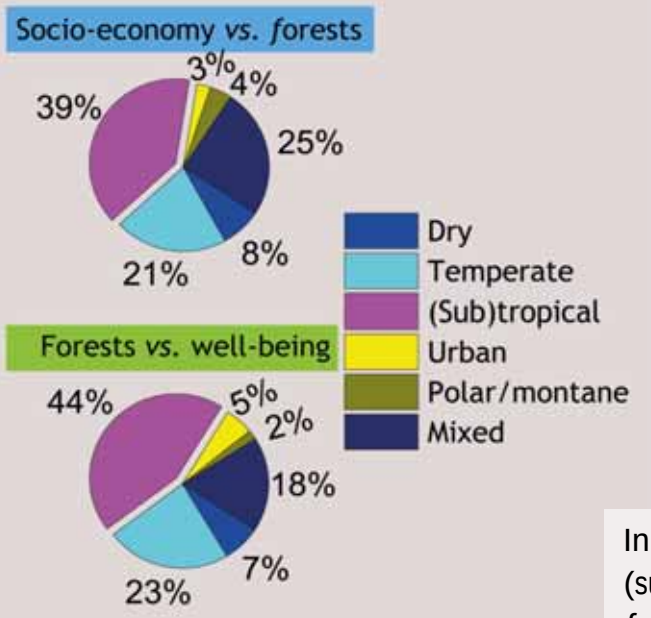


Fig. 7 Biomes studied in the literature on forests in relation to socio-economy or well-being, as identified in the systematic mapping. Grouping of all papers on biome was done using a global biome map (CIESIN, 2012). The category „urban“ was added to distinguish trees in cities from forests elsewhere. „Mixed“ points to papers studying more than one biome.

Interest till now was mainly on forests in (sub)tropical regions, rather than on the *marginal forests* in cold, arid, mountain or urban regions. Justified? Are they also of marginal importance?

Economies studied: bias towards developing countries

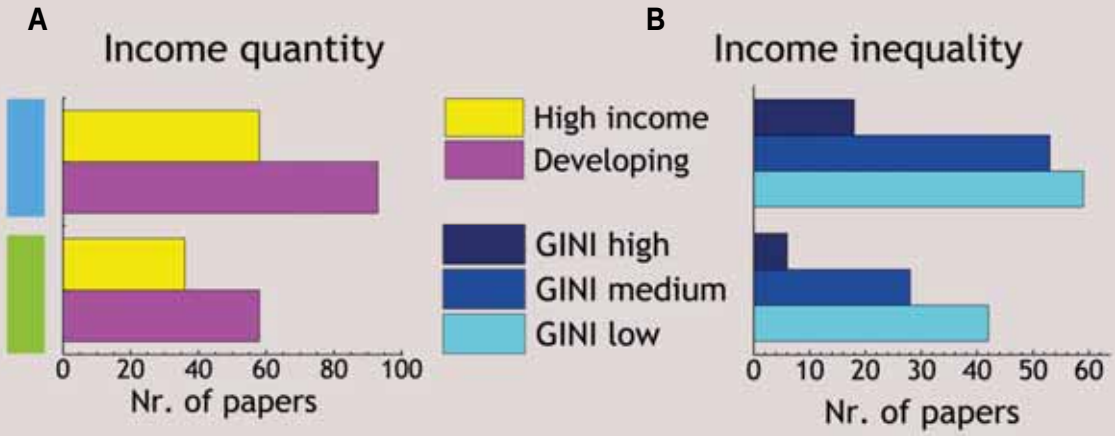


Fig. 8 A. Economy of the countries studied in literature on forests in relation to socio-economy or well-being, as identified in the systematic mapping. Countries were classified in high, middle and low economies, based on GNI per capita, calculated using the World Bank Atlas method. Low and middle income classes were then grouped to the category “developing”. **B.** Grouping of papers on Gini index (using the World Bank estimate), where 0 represents perfect equality and 100 perfect inequality. Groups were made as follows: Gini index 0-39 (low), 40-49 (middle) and 50-100 (high).

Box. 3 VALUE FOR MANY & BIG

Hotspot regions of global change are tropical rainforests but also semi-arid regions and mountain regions (Future Earth, strategic research agenda 2014). On top of the relatively few studies done in these biomes (Fig. 7), the Environmental Performance Index does not take them systematically into account as forests (Hsu *et al*., 2014). When monitoring forest cover change EPI analysis does not call a forest:

- forests of trees less than 5m tall
- forests in countries with less than 200 km² of forest with more than 50% tree cover

Indicators are leverage points in a system, like the world being a system composed of systems. Changing indicators is an easy way to change the behaviour of a system. Indicators arise from values and create values (Costanza *et al*., 2014; Meadows, 2008). Is it then justified to pay no attention to these vulnerable forests just because they are less dense with shorter trees? Are they of less value for human well-being? Maybe we should have a read in E.F. Schumacher's book *Small Is Beautiful: Economics as if People Mattered* (first published in 1973).

Socio-economy > forests > well-being interactions as mentioned in the literature

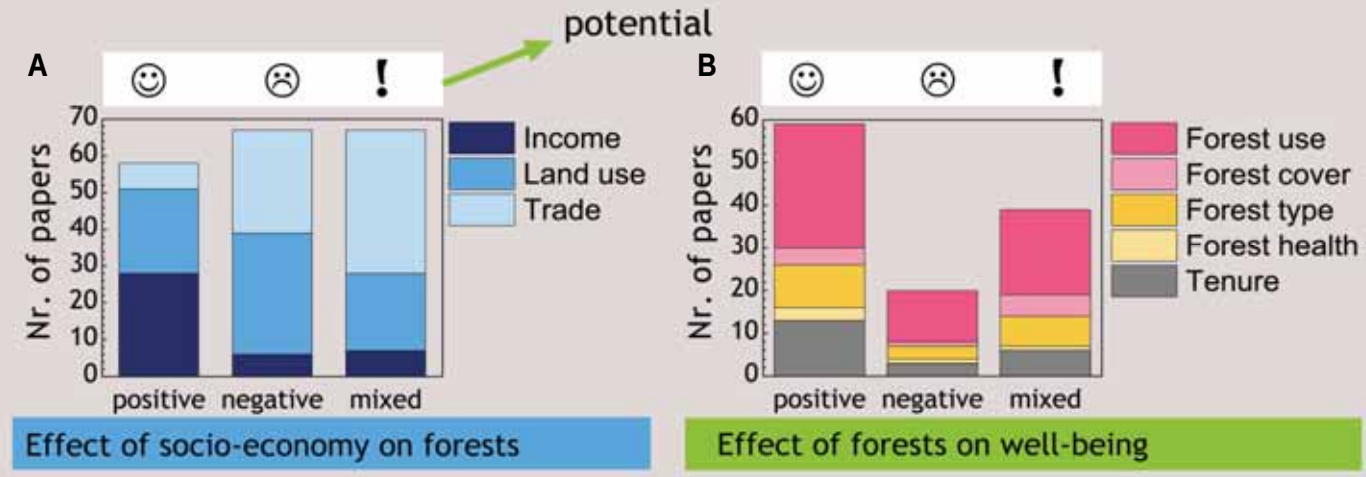


Fig. 9 Effect of **A.** socio-economic traits on forest traits and **B.** forest traits on well-being. Values are the number of papers found in the systematic mapping. Mixed effects, papers mentioning an interaction between socio-economy, forests, well-being but the effect of which is conditional.

Notice that the total number of studies is almost equal independent of the effect of socio-economy on forests. This is happy news as it means there is a great potential to turn the negative effects into positive ones by learning from the mixed effect studies (see Table 25).

The total number of papers reporting a positive effect of forests on well-being is importantly higher than the number of negative effect studies. Also here there is a high amount of mixed effect studies, indicating the power we have to turn negative effects of forests on well-being into positive ones.

HEALTH FOREST

Although the positive effect of forests in general on human health is clear (Karjalainen, 2010; Meyer & Bürger-Arndt, 2014; Papillon, 2014), the importance of forest health in this relationship has been little studied so far.

Forest traits had a predominantly positive effect on human well-being, but not always. The major negative effect of trees was found to be the use of fuel wood to cook or heat and the use of treated wood indoors, in both cases causing air pollution. Also the presence of ticks causing Lyme disease has been mentioned as a negative forest trait for well-being. The question here is: are the benefits of trees worth this trouble?

What has been studied in the categories TRADE & LAND USE?

Topics of the papers on „trade“ Min. count = 4

Topics of the papers on „land use“ Min. count = 4

Box. 4 JUST FOREST, NOT JUST A FOREST

Land use and trade were found to have mostly negative or mixed effects on forests. When looking at the topics studied in these two categories for developing and high income countries separately, a striking difference was found. Developing countries suffer from loss of quantity while high income countries face more quality loss and seem to be able to keep their forests; in a justified way?

Developing countries
Min. count = 3

Min. count = 3
High income countries

High-income countries displace a higher proportion of land use to foreign soil compared to developing countries (Weinzettel *et al*., 2013). If in the studies identified in this review the deforestation is also carried out for exporting purposes needs another study. Nevertheless, it is clear that to understand human-forest relationships on a global scale, we need to fill the knowledge gap of the effects of foreign land use on the well-being of both exporting and importing countries (for a general read on this issue: Lambin & Meyfroidt, 2011).

A man is rich
in proportion to the number of things
he can afford to let alone

H.D. Thoreau

Box. 5 ATTENTION FOR APPARENT CAUSALITIES

Papers studying the **effect of income** on forests looked mainly at forests in developing countries and rarely at forests in high income countries. In addition, the studies identified are not equally spread over the world (Table 11).

Therefore, we cannot conclude that wealth has a positive and poverty a negative impact on forests. We can only conclude that income in developing countries can have positive consequences for forests.

Table 11

Category	Economy	Effect +	Effect -	Effect +/-	*Total*
Income	Developing	20	3	0	*35*
Income	High income	2	0	0	*3*
Land use	Developing	5	7	7	*35*
Land use	High income	6	10	1	*27*
Trade	Developing	3	7	11	*21*
Trade	High income	1	9	8	*18*

Top 4 continents studied in relation to income ▼

Min. count = 2

Papers studying the **effect of land use** or **trade** on forests showed a consistent negative effect over countries of different economic status (Table 11). Positive note is the high potential for improvement (mixed effects), especially pronounced in the developing countries. Also here the studies are however not evenly distributed over the world. Top 3 and top 4 continents studied in relation to

land use ▼

Min. count = 7

and trade ▼

Min. count = 8

Data not included in Table 11 or in the word clouds:

10 studies on **land use** were done on a higher scale than the country level (on 1 or more continents, the latter indicated as „world“) of which 2 showed a positive, 5 a negative and 3 a mixed effect on forests.

30 studies on **trade** were done on a higher scale than the country level, of which 2 showed a positive, 12 a negative and 16 a mixed effect on forests.

Interacting factors with the forest/socio-economic traits

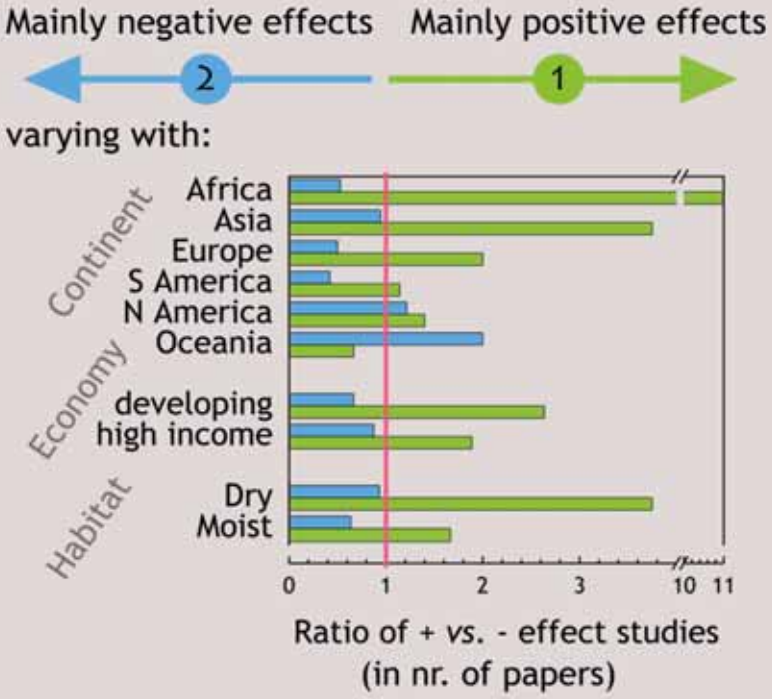


Fig. 10 Proportion of papers on forests in relation to socio-economy (●) or well-being (●) reporting positive effects to those reporting negative effects, categorized per continent, economy of the countries studied or habitat. Subdivision on economy is based on GNI per capita and the habitat subdivisions on the 14 major habitat types according to WWF, which were regrouped to represent the wetter and the drier regions (Table 4).

Papers on forest *vs.* well-being showed mainly positive effects of forests, while papers on socio-economy *vs.* forests reported mainly negative effects. However, there was a significant variation between subdivisions.

Africa and Asia showed significantly more papers reporting positive effects of forests on well-being relative to the other continents. Same trend was found for papers studying developing countries compared to high income countries and papers on dry habitats *vs.* moist ones.

Papers reporting negative effects of socio-economy on forests were especially numerous for studies on Africa, Europe and South America, while most positive effect studies were found for forests in Oceania and North America.

Box. 6 Economy, the dominant factor

Table 12 The three interacting factors of Fig. 10 can be brought back to one: economy. Values are nr. of papers. L, low income; M, middle income economies (together the developing economies).

Interacting factors	L & M income	High income	Ratio
Africa & Asia	42	3	14.0
Other continents	16	33	0.5
Dry habitats	20	9	2.2
Moist habitats	30	18	1.7

Forests stimulate well-being especially in poorer countries

Table 13 The three interacting factors can not be brought back to economy only. The higher ratio of positive to negative effect studies in dry habitats is not explained by economy. Values are nr. of papers.

Interacting factors	L & M income	High income	Ratio
Africa, Eur, S Am	48	11	4.4
Other continents	44	47	0.9
Dry habitats	24	8	3.0
Moist habitats	53	31	1.7

Socio-economy affects forests especially in poorer countries

The higher ratio of positive effect studies in dry habitats is linked to the topic of the studies.

Socio-economic subcategories studied in papers on forests in:

Dry habitats

Moist habitats

Which diversity to keep?

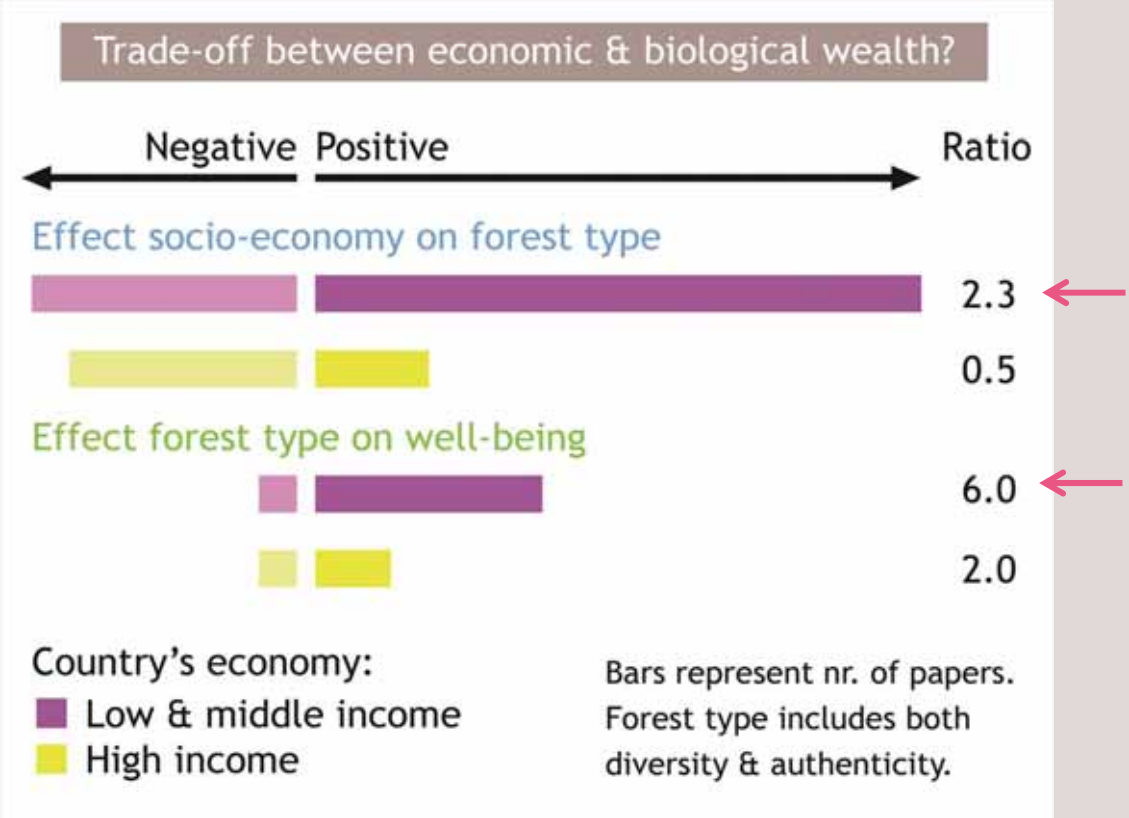


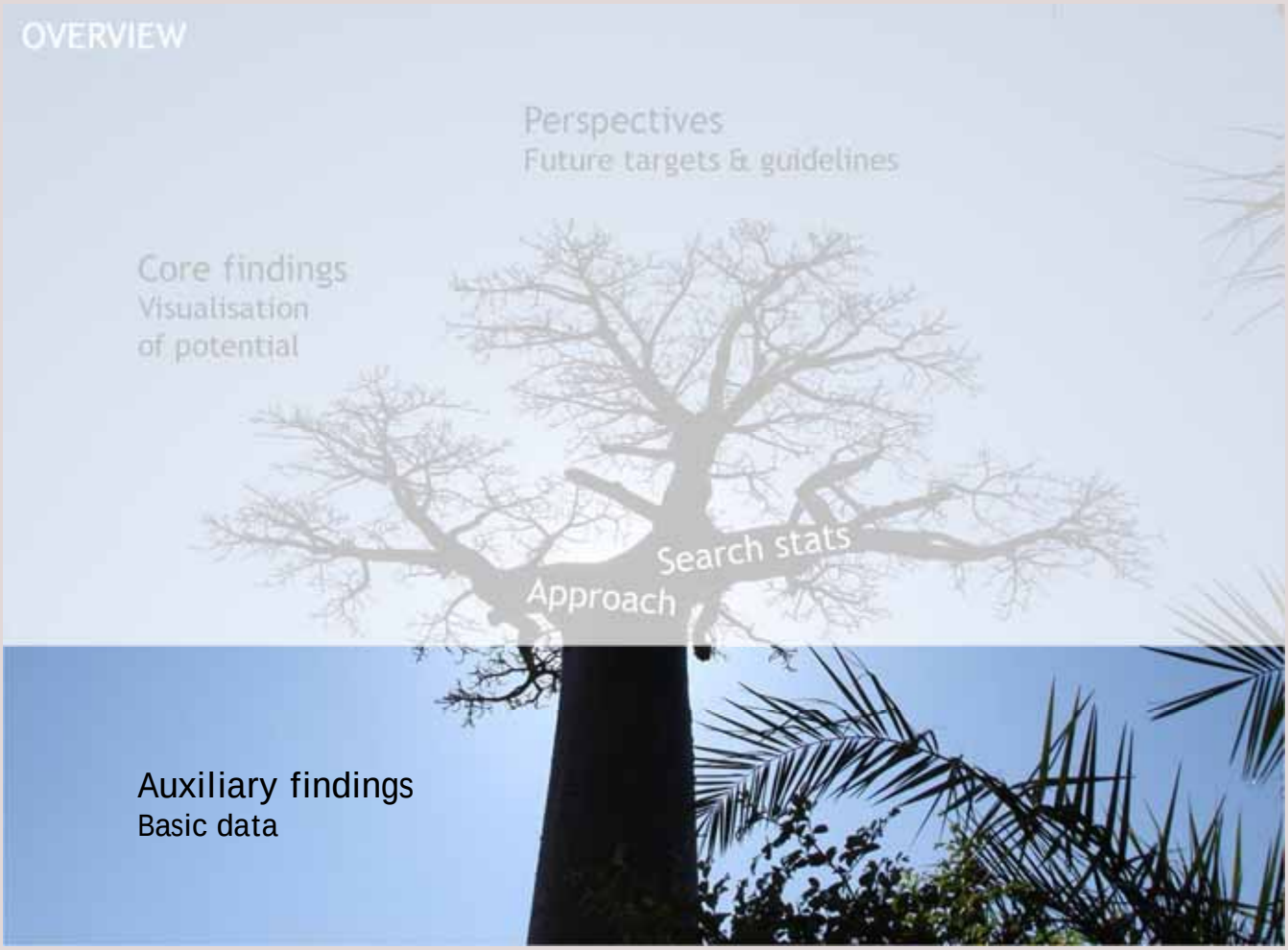
Fig. 11 The number of papers reporting a positive effect of socio-economy on forest type relative to those reporting a negative effect, categorized on the country's economy. Same information is shown for papers on forests in relation to well-being.

Given the number of studies per topic, socio-economic conditions in developing countries stimulated forest diversity more. Forest diversity stimulated well-being significantly more in developing countries than in richer countries.

The countries studied for the effect of socio-economy on forests or the effect of forests on well-being are listed below.

Socio-economy *vs.* forests		Forests *vs.* well-being	
India Brazil China Ethiopia Vietnam	Canada Chile Finland Australia Hawaii USA	India Indonesia Tanzania Bangladesh Ethiopia Brazil	USA Spain Australia New Zealand Japan
Min. count = 4	Min. count = 2	Min. count = 2	Min. count = 3

IV. Auxiliary findings



Auxiliary findings

Variation in topics studied

Variation over forest traits & well-being

Table 14 Forest traits studied for their impact on human well-being. Values are the number of papers found in the systematic mapping. Totals exclude duplicates. The traits searched on are indicated in yellow, the others were used only for data extraction and are hence not representative of the literature available on those topics.

Forest traits		Well-being				*Total*
		General	Physical	Mental	Social	
WHAT? FUSE	forestry for profit	16	5	3	2	*25*
	forestry subsistence	15	5	0	3	*20*
	forest recreation	2	2	0	1	*5*
	forest reserve	1	2	0	0	*3*
	urban trees	3	4	1	0	*8*
Total		**36**	**18**	**4**	**5**	*59*
HOW? FTYPE	diversity	6	3	0	0	*9*
	authenticity	8	1	0	2	*11*
Total		**14**	**4**	**0**	**2**	*20*
FHEALTH						
Total		**2**	**3**	**0**	**1**	*5*
TENURE	private	1	0	0	0	*1*
	state	2	0	0	0	*2*
	communal	12	0	0	1	*13*
	access	2	1	0	2	*5*
	mixed	0	0	0	0	*0*
Total		**17**	**1**	**0**	**3**	*21*
FCOVER						
Total		**6**	**3**	**0**	**1**	*10*
	Grand total	*73*	*29*	*4*	*11*	*112*

Most research has been done on WHAT forests are used for and the impact on well-being, rather than on HOW forests are used. Especially the effect of forests' health on human well-being received little attention so far.

Variation over socio-economic traits & forest traits

Table 15 Socio-economic traits studied for their impact on forest traits. Values are the number of papers found in the systematic mapping. Totals exclude duplicates. The traits searched on are indicated in yellow, the others were used only for data extraction and are hence not representative of the literature available on those topics.

Forest traits		Socio-economic traits				*Total*
		Income	Land use	Occupation	Demography	
FUSE	forestry for profit	0	29	2	3	*32*
	forestry subsistence	3	9	0	4	*13*
	forest recreation	0	2	0	0	*2*
	forest reserve	1	12	0	1	*13*
	urban trees	1	0	0	1	*2*
Total		**5**	**53**	**2**	**10**	*65*
FTYPE	diversity	10	28	1	0	*35*
	authenticity	3	4	0	4	*10*
Total		**13**	**31**	**1**	**4**	*44*
FCOVER						
Total		**26**	**37**	**2**	**12**	*60*
FHEALTH						
Total		**0**	**33**	**1**	**8**	*42*
TENURE	private	0	2	0	2	*4*
	state	0	1	0	0	*1*
	communal	2	0	0	1	*3*
	access	0	0	0	0	*0*
	mixed	0	0	0	1	*1*
Total		**2**	**3**	**0**	**4**	*9*
	Grand total	*44*	*134*	*6*	*35*	*193*

Variation over topics & continents

Table 16 Available information per continent about the effect of forest traits on well-being. Values are number of papers found by the systematic mapping. Totals exclude duplicates. *World* indicates papers on more than one continent.

Forest & Well-being study categories		Studied continent						
		Africa	Asia	Europe	N Am.	Oceania	S Am.	World
Forest traits								
FCOVER								
Total		**2**	**2**	**1**	**1**	**1**	**3**	**0**
FUSE	forestry for profit	2	9	1	6	1	1	4
	forestry subsistence	11	6	1	0	0	1	1
	forest recreation	0	1	3	1	0	0	0
	forest reserve	1	1	0	0	0	1	0
	urban trees	0	1	3	2	1	0	1
Total		**14**	**18**	**8**	**9**	**2**	**3**	**6**
FTYPE	diversity	0	3	1	1	0	4	0
	authenticity	1	1	0	0	2	5	2
Total		**1**	**4**	**1**	**1**	**2**	**9**	**2**
FHEALTH								
Total		**0**	**0**	**3**	**2**	**0**	**0**	**0**
TENURE	private	0	0	1	0	0	0	0
	state	0	1	0	1	0	0	0
	communal	3	4	0	1	1	3	1
	access	2	2	0	1	0	0	0
	mixed	0	0	0	0	0	0	0
Total		**5**	**7**	**1**	**3**	**1**	**3**	**1**
Well-being traits								
GENERAL		19	23	7	6	3	11	4
PHYSICAL		4	3	5	8	2	4	2
MENTAL		0	0	0	1	0	0	3
SOCIAL		2	2	3	1	1	2	0
Grand total nr. of papers		*22*	*27*	*14*	*16*	*6*	*17*	*9*

Most studies on the well-being impact of:

➤ **forest use** are done in Asia (focus on forestry for profit) and Africa (focus on subsistence forestry)

➤ **forest type** are done in South America

Table 17 Available information per continent about the effect of socio-economic traits on forest traits. Values are number of papers found by the systematic mapping. Totals exclude duplicates. The traits searched on are indicated in yellow, the others were used only for data extraction and are hence not representative of the literature available on those topics.

Socio-economic & forest study categories		Studied continent						
		Africa	Asia	Europe	N Am.	Oceania	S Am.	World
Socio-economic traits								
INCOME								
Total		**15**	**16**	**0**	**3**	**0**	**9**	**1**
LAND USE	land use	10	17	6	22	3	9	6
	trade	8	12	12	11	4	15	12
Total		**18**	**28**	**16**	**32**	**7**	**23**	**15**
OCCUPATION	Otype	1	3	0	0	0	0	0
	innovation	0	0	0	2	0	0	0
Total		**1**	**3**	**0**	**2**	**0**	**0**	**0**
DEMOGRAPHY	demography	3	5	0	1	1	2	0
	Pdensity	0	2	0	1	0	1	0
	politics	0	1	1	1	2	1	1
	education	3	1	1	6	2	3	2
Total		**6**	**9**	**2**	**9**	**3**	**5**	**3**
Forest traits								
FUSE	forestry for profit	3	7	5	4	3	8	4
	forestry subsistence	3	6	0	1	0	3	0
	forest recreation	0	0	0	2	0	0	0
	forest reserve	1	3	1	1	1	3	3
	urban trees	1	0	0	0	1	0	0
Total		**9**	**15**	**6**	**8**	**4**	**13**	**7**
FTYPE	diversity	10	7	4	3	1	7	3
	authenticity	4	0	0	2	1	3	0
Total		**12**	**7**	**4**	**5**	**2**	**10**	**3**
FCOVER								
Total		**14**	**25**	**1**	**5**	**1**	**14**	**7**
FHEALTH								
Total		**1**	**2**	**7**	**26**	**2**	**2**	**4**
TENURE	private	0	0	0	3	0	0	1
	state	0	0	0	1	0	0	0
	communal	1	1	0	1	0	0	0
	access	0	0	0	0	0	0	0
	mixed	0	1	0	0	0	0	0
Total		**1**	**2**	**0**	**5**	**0**	**0**	**1**
Grand total nr. of papers		*28*	*46*	*15*	*40*	*8*	*31*	*25*

Studies on forest health are nearly exclusively done in Nort America, while studies on income effects on forests are mainly done in Africa & Asia.

Variation over biomes

Table 18 Number of papers identified by the systematic mapping on socio-economy & forests (●) or forests & well-being (●) per biome studied. Biomes follow CIESIN (2012) and were regrouped to present the drier and the wetter regions (Table 4).

Biomes	% forest area*	% land area**	Socio-economy *vs.* forests		Forests *vs.* well-being	
			Nr.	% papers	Nr.	% papers
Dry	5	18	15	8	8	7
Temperate	28	17	41	21	26	23
→ (Sub)tropical	40	24	76	39	49	44
Av. dry			**35**	**18**	**31**	**28**
→ **Av. moist**			**97**	**50**	**52**	**46**
Urban			5	3	6	5
Polar/montane	25	40	8	4	2	2
Mixed			48	25	20	18

Mixed, studies on an area covering multiple biomes

* Biome % area was adapted from Wade *et al.* (2003), recalculating percentages to present % forest cover.

** Adapted from The Nature Conservancy (TNC) Terrestrial Ecoregional Boundaries.

Interest till now was mainly on forests in moist (sub)tropical regions, which can be linked to global forest area distribution.

If we compare the distribution of papers over the different biomes with the forest distribution, we find a good match. The exception are the polar and montane forests. This might be linked to:

- the language gap, with most of the forests situated in Russia
- the topic of the review being not the research focus for those forests

Socio-economy > forests > well-being interactions as mentioned in the literature

Table 19 Effect of forest traits on human well-being. Values are the number of papers found in the systematic mapping. Totals exclude duplicates.

Forest traits		Effect on human well-being				*Total*
		no	negative	positive	mixed	
FUSE	forestry for profit	0	7	8	10	*25*
	forestry subsistence	0	3	13	4	*20*
	forest recreation	0	1	2	2	*5*
	forest reserve	0	1	1	1	*3*
	urban trees	0	0	5	3	*8*
Total		**0**	**12**	**29**	**20**	*59*
FTYPE	diversity		1	5	3	*9*
	authenticity		2	5	4	*11*
Total		**0**	**3**	**10**	**7**	*20*
FCOVER		0				
Total		**0**	**1**	**4**	**5**	*10*
FHEALTH						
Total		**0**	**1**	**3**	**1**	*5*
TENURE	private	0	0	0	1	*1*
	state	0	0	1	1	*2*
	communal	0	3	7	4	*13*
	access	0	0	5	0	*5*
	mixed	0	0	0	0	*0*
Total		**0**	**3**	**13**	**6**	*21*
	Grand total	*0*	*20*	*58*	*39*	112

Box. 7 INTERPLAY WITH THE HUMAN DEVELOPMENT INDEX

Table 20 Number of papers identified in the systematic mapping reporting positive or negative effects of socio-economy on forests or forests on well-being, grouped on the Human Development Index ranks in 2013 (from the 2014 Human Development Statistical Tables). Rank 1 corresponds to the highest HDI.

Subject	Effect	HDI rank			Median
		1-20	**21-100**	**>100**	HDI rank
Socio-economy *vs.* forests	+	20	11	30	91
	-	21	10	24	79
	Ratio	1.0	1.1	1.3	
Forests *vs.* well-being	+	15	13	24	90
	-	4	2	7	121
	Ratio	3.8	6.5	3.4	

The Human Development Index (HDI) is a summary measure of average achievement in key dimensions of human development: a long and healthy life, being knowledgeable and have a decent standard of living.

Table 21 Effect of socio-economic traits on forest traits. Values are the number of papers found in the systematic mapping. Totals exclude duplicates. The traits searched on are indicated in yellow, the others were used only for data extraction and are hence not representative of the literature available on those topics.

Socio-economic traits		Effect on forest traits				*Total*
Category	Subcategory	no	negative	positive	mixed	
INCOME						
Total		**3**	**6**	**28**	**7**	*44*
LAND USE	land use	4	33	23	21	*74*
	trade	0	28	7	39	*69*
Total		**4**	**59**	**30**	**60**	*134*
OCCUPATION	Otype	0	0	2	2	*4*
	innovation	0	0	2	0	*2*
Total		**0**	**0**	**4**	**2**	*6*
DEMOGRAPHY	demography	0	3	5	4	*12*
	Pdensity	0	3	0	1	*4*
	politics	0	5	0	2	*6*
	education	0	0	18	0	*17*
Total		**0**	**11**	**22**	**6**	*35*
	Grand total	*7*	*71*	*73*	*74*	*193*

Table 22 Overview of the effect of socio-economic traits on forest traits and the effect of forest traits on well-being. Values are the number of papers found in the systematic mapping.

Effect on forests of:						**Forest traits studied**		Effect on **well-being**	
Income		**Land use**		**Trade**					
-	**+**	**-**	**+**	**-**	**+**	Cat.	Sub-category	**-**	**+**
0	0	1	3	4	2	FUSE	forestry for profit	7	8
0	2	1	3	2	0		forestry subsistence	3	13
0	0	2	0	0	0		forest recreation	1	2
0	1	0	2	3	1		forest reserve	1	1
0	1	0	0	0	0		urban trees	0	5
6	13	11	4	5	4	FCOVER	Fcover	1	4
0	8	6	4	7	1	FTYPE	diversity	1	5
0	3	3	1	0	0		authenticity	2	5
0	0	12	6	8	0	FHEALTH	Fhealth	1	3
0	0	1	1	0	0	TENURE	private	0	0
0	0	0	0	0	0		state	0	1
0	2	0	0	0	0		communal	3	7
0	0	0	0	0	0		access	0	5
0	0	0	0	0	0		mixed	0	0

Interfering factors with the forest traits in their effect on well-being

Table 23 Number of studies done per forest/study characteristic and per type of effect on human well-being. Values are the number of papers found in the systematic mapping. In colour the characteristics are indicated interacting most strongly with the forest traits in their effect on well-being.

Forest/Study characteristics	Effect on human well-being		
	positive	negative	mixed
Forest category			
Fuse	29	12	20
Ftype	10	3	7
Fcover	4	1	5
Fhealth	3	1	1
tenure	13	3	6
Studied continent			
Asia	15	4	13
Africa	11	1	11
S America	8	7	4
N America	7	5	4
Europe	6	3	5
Oceania	2	3	1
Economy			
low&middle income	29	11	26
high income	17	9	10
GINI			
GINI low	23	5	18
GINI medium	13	8	9
GINI high	4	2	0
Habitat type			
(Sub)tropical	23	10	20
Temperate	11	8	7
Dry	6	1	2
Dry	15	4	13
Moist	25	15	16
Polar/montane	1	1	0
Urban	4	0	2

The impact of forests on well-being was mostly reported to be:

- positive for countries of low inequality in the (sub)tropics of Asia & Africa
- negative in the Americas
- promising in developing countries of low inequality in Asia & Africa

Economy: Countries were classified in high, middle and low economies, based on GNI per capita, calculated using the World Bank Atlas method.

GINI: a Gini index (using the World Bank estimate) of 0 represents perfect equality and and index of 100 perfect inequality. Groups were made as follows: Gini 0-39 (low), 40-49 (middle) and 50-100 (high).

Habitat: see Table 4

Table 24 Number of studies done per socio-economic/study characteristic and per type of effect on forests. Values are the number of papers found in the systematic mapping. In colour the characteristics are indicated interacting most strongly with the socio-economic traits in their effect on forests.

Socio-economic/Study characteristics	Effect on forest traits		
	positive	negative	mixed
Socio-economic category			
Income	15	6	7
Poverty	0	13	0
Land use	30	59	60
Occupation	4	0	2
Demography	22	11	6
Studied continent			
Africa	9	17	10
Asia	17	18	22
Europe	3	6	7
N America	17	14	10
Oceania	4	2	3
S America	8	19	12
Economy			
low&middle income	28	42	36
high income	21	24	17
GINI			
GINI low	19	22	21
GINI medium	15	25	17
GINI high	8	7	6
Habitat type			
(Sub)tropical	20	35	35
Temperate	15	22	8
Dry	9	5	2
Dry	14	15	10
Moist	30	47	35
Polar/montane	3	3	2
Urban	1	3	3

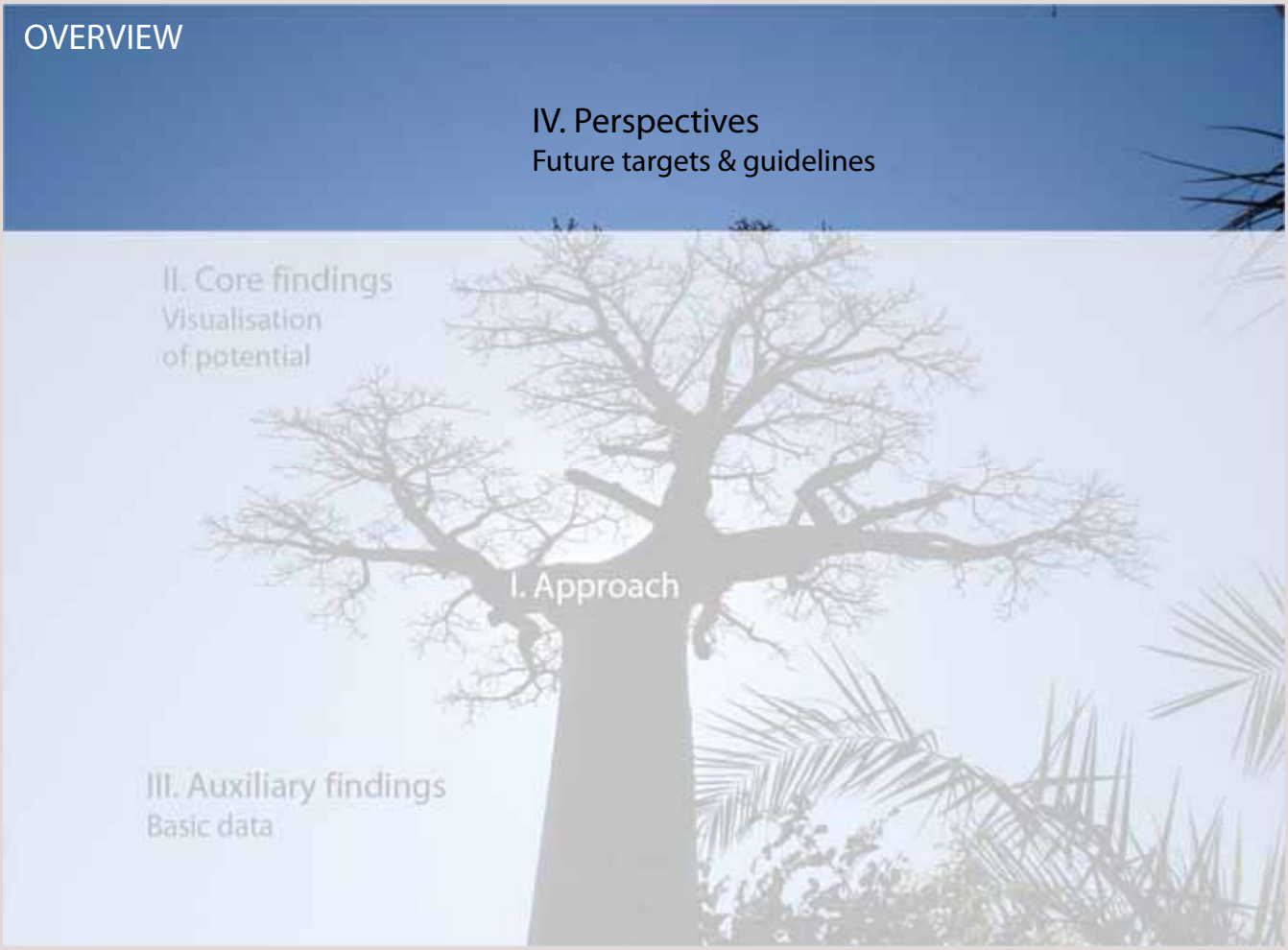
- Socio-economic factors impacting forests positively, were mainly reported in Asia & North America
- The negative impacts of mainly land use were studied most in developing countries in South America, Asia & Africa
- The highest potential to benefit forests was found in land use change in (sub)tropical Asia

Economy: Countries were classified in high, middle and low economies, based on GNI per capita, calculated using the World Bank Atlas method.

GINI: a Gini index (using the World Bank estimate) of 0 represents perfect equality and and index of 100 perfect inequality. Groups were made as follows: Gini index 0-39 (low), 40-49 (middle) and 50-100 (high).

Habitat: see Table 4

IV. Perspectives



Perspectives

Knowing the limitations of this study, what can we conclude from the findings? What do we know already and what questions need more attention in the future?

First, I will list the **knowledge gaps** identified giving us some **future targets**. Gaps this means, gaps in the English literature published in journals, part of the Web of Science Core collection.

Second, I will give some **guidelines** for the management of socio-economy and forests aiming at well-being for all. Word clouds are shown of the most reported socio-economic and forest factors related with positive or negative effects on forests and well-being, respectively. Given the serious knowledge gaps to date, these guidelines are **in an embryonal stage**. They are far from generally appliccable as they are biased by the uneven distribution of the number of studies done in different continents, habitats and economies.

To end, I give a **wish-list** of studies to be done in future if we want to liberate this study from its limitations.

Vision Action Flower



Future targets

Knowledge gaps

The main finding of this study is the non-systematic way research takes place leading to a dispersed knowledge base. Now we have identified the gaps we can start filling them. Below I conclude on the research bias identified by mentioning the major and minor topics studied so far and ranking them based on the degree of the bias.

While not mentioned in the list of knowledge gaps, as only English articles were included in the study, a LANGUAGE GAP could explain at least partly some of the other gaps. The few studies done on northern forests and in Europe (relative to the forest area) might be linked to research published in Russian (see also, Box 1).

Studies touching upon different disciplines are gaining interest. However, if we want to get an integrated understanding of forests in relation to man and society we should also include studies in different languages. Only in this way we will be able to consider different world views, which will be related to the topics studied, that in turn will be linked to factors such as main vegetation type, religion, politics, habits and values of the different language regions.

To solve the issue of non-systematic research progress I have an idea:

We could establish a *research enterprise*. Universities would be grouped and managed based on the research topics they handle. Each group of universities would work on one big problem with all the different disciplines present at the universities. Within each group the different world views would be represented by f.ex. taking a university from each climate zone (immediately also linked to socio-economic factors).

Biome gaps

39-44% (●-●) of the studies has been done on forests in the (sub)tropics and 21-23% on temperate forests. While the little interest in **dry forests** is conform the much smaller area they occupy in the world, the meager reporting on **forests of the north or in montane areas** is surprising.

The question then raises, should the extent of the research be in proportion to the extent of the forest or to its importance for human well-being or the extent of the threats it is subjected to?

Topic gaps

● Studies on the effect of land use were nicely balanced over the different forest traits studied. In contrast, studies on the effect of trade looked in 50% of the cases to effects on forest use. Knowledge on the **effect of trade on forest type** is hence largely lacking. Although still accounting for around 25% of the studies, less research was done on the effects of income on forests. More than half of the studies looked at the effect of income on forest health, leaving **income effects on forest use and forest type** largely blank.

● 50% of the research on forests in relation to well-being focuses on the effect of forest use on well-being. Almost 50% of these papers deal with forests used for profit or subsistence. Clear gaps are the effect of especially **forest health** but also **forest type** (species number, native or exotic, gymnosperm or angiosperm , plantation or natural) and the type of **forest tenure on well-being**.

Bias gradient: minor cat / major cat

Within the category of forest use, the effect of forest recreation, forest reserves and urban forests on well-being did also receive little attention. Rather than being a real knowledge gap, their more social character might however explain why studies on these topics were not picked up using Web of Science Core Collection only.

Continent gaps

25% of the studies have been done on forests in Asia with almost half of the studies done in Asia and North America (●) or Asia and Africa (●). Especially **European forests** leave a huge gap in the findings of the review relative to their world share in forest area. In comparison to the forest area inAsia, also Africa and South America were little studied for their socio-economic impact on forests (●) and the Americas for their forest impact on well-being (●).

Economies gap

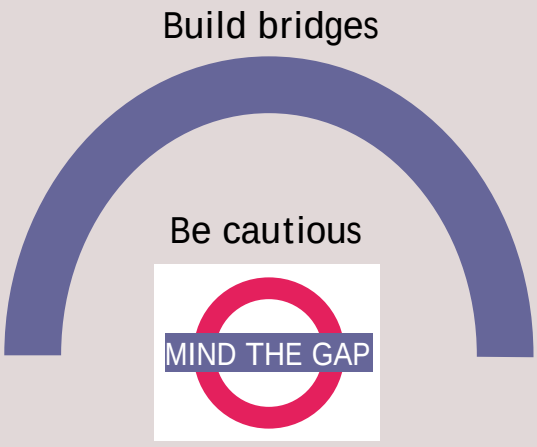
62% of the studies took place in developing countries. Forests are hence less studied for their relation to socio-economic traits or well-being in **high income countries**. Although only for 67% of the studies a GINI index could be added (GINI data not available for the studied country or study on more than one country), forests in **countries with a high GINI index** were clearly less studied (● 14%, ● 8% of studies). An easy explanation might here be the link between economic inequality and educational opportunity or academic freedom.

Guidelines

The following word clouds show socio-economic, forest or well-being data extracted from abstracts from the papers identified in the systematic mapping. Word size is relative to the frequency the word occurs in the different papers. The top 10-15 words are shown and the min. word count of the words in the word cloud is each time given, which is in proportion to the amount of papers on the topic. For the word clouds based on subsets of data the top 3-15 words are shown (preference was to show key-words that occurred at least in two papers but for subsets with few papers this reduced the dataset sometimes below a relevant level of information sharing).

To interprete these data, be wary of the limitations of the study. The term „guideline“ should be interpreted within the limits of (i) the study ánd (ii) the current knowledge. First, word clouds are shown including all data. These data are biased, as mentioned in the chapter on „Research bias“, towards certain continents, habitats, economies and topics. Then, word clouds are shown including only the data of the conditions that have been most studied so far. For these specific conditions the „guidelines“ will be more robust.

This review has the goal to inspire. You will come across findings thinking „this is not true!“. Well, this is what the current English literature of the Web of Science Core Collection tells us. The following findings should hence stimulate further research to fill the gaps and get rid of the bias.



MIND THE GAP

Word clouds are based on all data collectively, without correction for any bias.

TO **CURB** – STIMULATE - ADAPT ☹

Socio-economic traits with a reported negative effect on forest traits

Min. word count = 4

negative

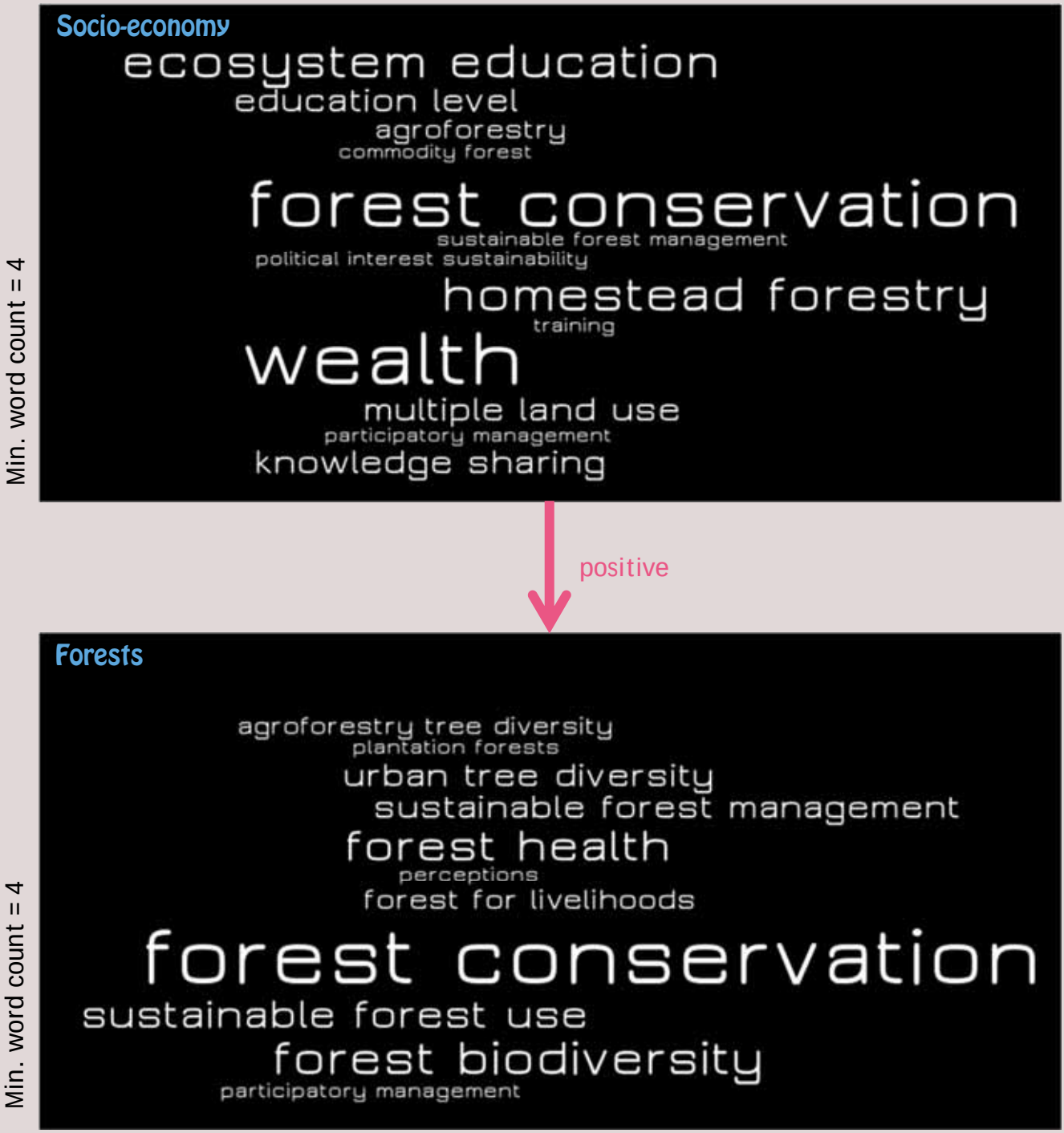
Min. word count = 5

To **curb** – stimulate - adapt ☹

Forest traits with a reported negative effect on well-being

TO CURB – **STIMULATE** - ADAPT ☺

Socio-economic traits with a reported positive effect on forest traits



TO CURB – **STIMULATE** - ADAPT ☺

Forest traits with a reported positive effect on well-being

TO CURB – STIMULATE - **ADAPT**

Mediating factors to transform negative into positive impacts

Table 25 Mediating factors determining the outcome of the interactions between socio-economy, forests and well-being. Data are a synthesis of the information contained in the abstracts from the papers identified in the systematic mapping, presenting mixed effects of socio-economy on forests or forests on well-being.

Basic human needs	Mediating factors	Description of mediating factors mentioned in mixed effect studies
Health & nice environment	Ecological will	sustainable forest mgmt, land use mgmt (income-conservation trade-offs)
	Ecological means	environmental education, spatial & temporal settings
Livelihood & something to do	Economic will	employment/market access, income, facilitation logistics & new techniques
	Economic means	access rights, equitable benefit sharing, entrepreneurship, trade relations
Social contact & growth potential	Public interest	consumption rate, willingness to pay, interests & perceptions
	Public means	participation (PFM), capacity building, technical guidance (social & human capital)
Management	Political interest	rules & regulations, monetary incentives, PFM institutions, certification systems
	Action	implementation policy guidelines, investment goals & time horizon

In short: how - → + ?

Manage land & people pursuing fulfillment of **everyone**'s human needs, accounting for **variation** in the biophysical & socio-economic environment and supported by the **government**.

Box. 8 THE SJERCA WAY OF LIFE (Ioan Negrutiu, Institut Michel Serres)

The factors mediating the outcome of socio-economic traits on forest traits or forest traits on well-being could be grouped according to the basic human needs. This agrees with the point of view of *the SJERCA way of life* (see next page) to get to sustainable development.

Taking care of world's ecosystems (forests in our case) can only lead to sustainable living if it goes hand in hand with taking care of world's people. If this view is accepted by everyone, the flow will start running from the current situation to a way of living that takes care of environment and man.

The only way to sustainable development: SJERCA

Ioan Negrutiu, Institut Michel Serres

All decisions & actions should be tested against 3 principles

Social Justice + **Environmental responsability** + **Cultural acceptance** = sustainable development

Everyone should have access to basic needs & rights

INSEPERABLE

All your actions must be in phase with the life supporting capacity of ecosystems

Agreement by everyone that this is the only way to go

ACCELERATOR

Universal goals to be accepted at global scale

then translated into

Specific goals & instruments to be accepted at local scale

global

If done so, a transition focused on ALL resources will result

All resources:
Physical resources
Institutions
Intellectual knowledge

By taking care of all →

All world problems, that is climate change, biodiversity loss, poverty & their relatives will get resolved on the way (the SJERCA way)

local

One way but there are different paths you can follow

All paths have to be adapted to local conditions & be adaptive, that is resilient.

if local action

Universal social protection floor will be built

leading to

equality
because of a resource redistribution
conform the 3 principles

MANUAL OF THE 2-COMPONENT-GLUE:

mix SJ & ER and add accelarator
expose to ambient conditions
wait for stabilization
> guaranteed bonding
> environment friendly

Word clouds are based on sub-sets of data, representing research majorities, to minimize skewed messages.

I. Data categories that showed a systematic increase over the study period (see Table 10)

Socio-economy

Forest traits reported to be affected by **income** in **Africa & Asia**

Only three papers reported a negative effect of income on forests. Two mentioned improved welfare leading to deforestation and overexploitation. One reported on overexploitation as a result of unfair benefit sharing.

Forest

Socio-economic traits reported to affect **forest cover** in **Asia**

Negative socio-economic actors

☹

Socio-economy

poverty
economic pressure
forest dependence
land shortage
agricultural demand
population increase
agri expansion

Min. word count = 2

Positive socio-economic actors

☺

agroforestry
NTFPs use multiple land use
religion
diversified income sources
forest independence
wood import
land holdings
wealth
ecosystem education
homestead forestry

Min. word count = 1

Forest

Socio-economic traits reported to affect **forest health** in **North America**

Negative socio-economic actors

☹

Socio-economy

international trade
forest conversion
road use

Min. word count = 2

Positive socio-economic actors

☺

knowledge sharing
perceptions
multiple land use
participatory management
ecosystem education

Forest health?

> forest traits mentioned in relation to forest health & socio-economy in **North America**

Min. word count = 2

Forest characteristics reported to affect well-being in **Asia**

Negative forest actors

☹

Min. word count = 1

Positive forest actors

☺

Min. word count = 2

Notice that both forest use (forest cover loss) and forest conservation are mentioned as having a negative impact on well-being. These studies were done in India and Nepal, developing countries. This shows well that environmental responsability should go hand in hand with social equity to get to sustainable development.

II. Data sets of categories that were most studied and hence are most reliable

Forest

Socio-economic traits reported to influence (sub)tropical forests

Negative socio-economic actors

☹

Min. word count = 3

Positive socio-economic actors

☺

Min. word count = 3

Traits of forests in the **(sub)tropics** reported to be influenced by **socio-economy**

Min. word count = 6

Traits of forests in the **(sub)tropics** reported to influence **well-being**

NEGATIVE FOREST ACTORS

☹

Min. word count = 1

POSITIVE FOREST ACTORS

☺

Min. word count = 2

Well-being variables reported to be influenced by **(sub)tropical forests**

Min. word count = 4

Forest

Socio-economic traits reported to influence **temperate forests**

NEGATIVE SOCIO-ECONOMIC ACTORS

☹

Min. word count = 2

POSITIVE SOCIO-ECONOMIC ACTORS

☺

Min. word count = 2

Traits of **temperate forests** reported to be influenced by **socio-economy**

Min. word count = 4

Traits of **temperate forests** reported to influence **well-being**

NEGATIVE FOREST ACTORS

☹

Min. word count = 1

POSITIVE FOREST ACTORS

☺

Min. word count = 2

Well-being variables reported to be influenced by **temperate forests**

Min. word count = 2

More reliable

Socio-economic traits reported to influence forests in ◣ **developing** *vs.* **high income** countries ◢

Less reliable

Min. word count = 4

Negative socio-economic actors

☹

Min. word count = 3

Min. word count = 4

Positive socio-economic actors

☺

Min. word count = 3

More reliable

Forest traits reported to influence well-being in ◣ **developing** *vs.* **high income** countries ◢

Less reliable

Min. word count = 2

☹

Min. word count = 2

Min. word count = 2

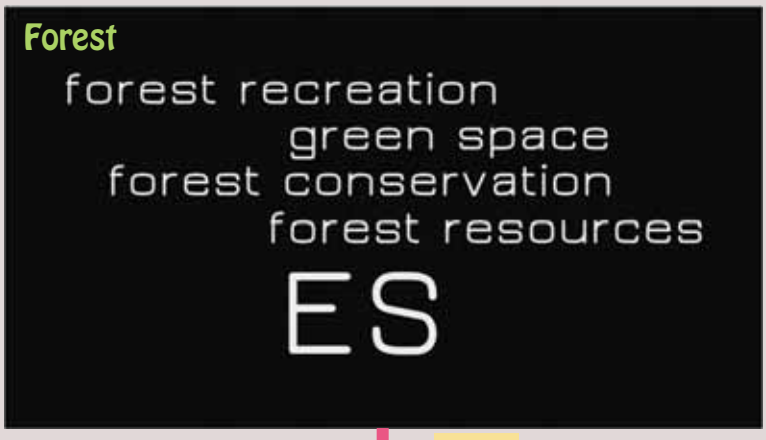
☹

Min. word count = 2

Min. word count = 4

☺

Min. word count = 5



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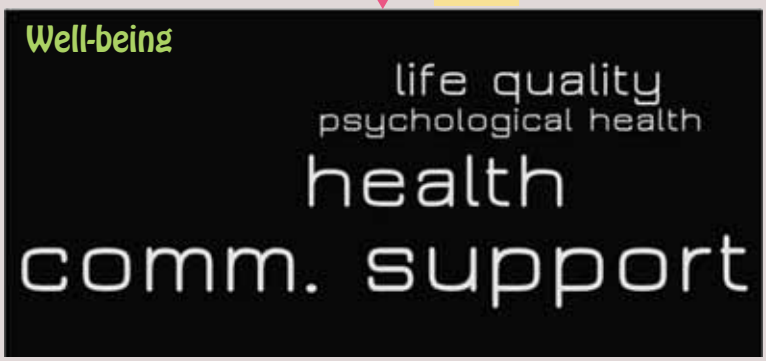

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Box. 9 Lost connection

The relation between forests and well-being is:

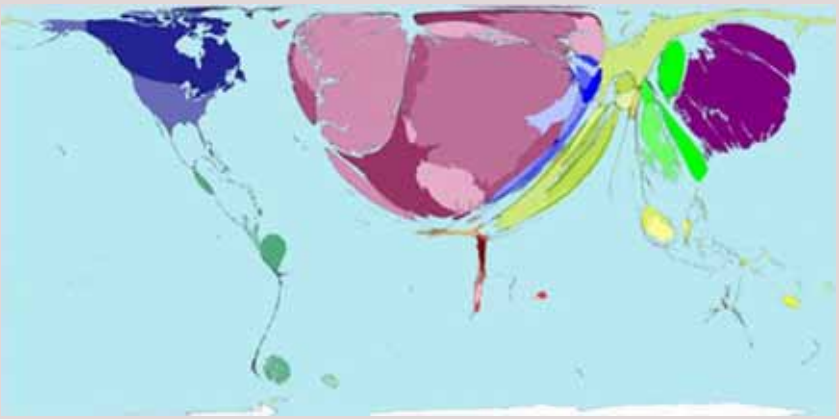
➤ simple in **developing countries** where forests contribute to covering basic needs and equality

➤ more diverse in **high income countries** where basic needs are already covered and forests are mainly mentioned in relation to provision of ecosystem services rather than goods

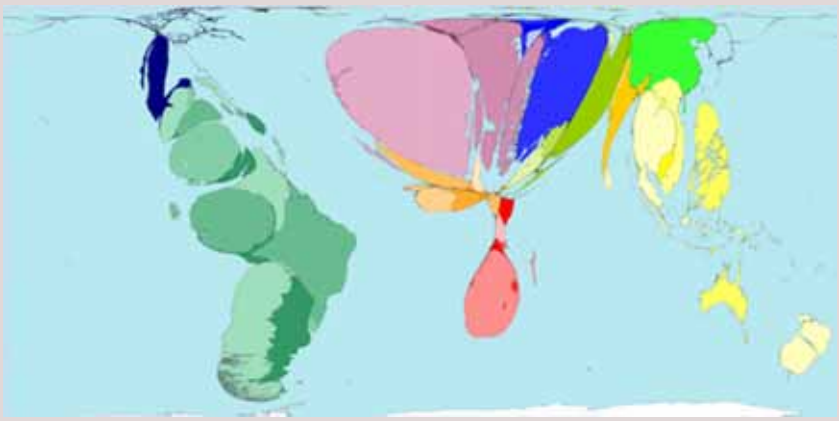
Forest traits contributing to well-being in high income countries are thus not necessarily the same as in developing countries. However, at least part of the well-being aspects are universal but in high income countries not experienced anymore as forest goods or services because of the indirect link.

Only think about all food products from tree origin, that are even more consumed in high income countries than in developing countries (see maps below), and all wood used in construction and furniture.

http://www.worldmapper.org



Territory size shows the proportion of worldwide **net imports of fruit** (in US$) that are received there. Net imports are imports minus exports. When exports are larger than imports the territory is not shown.



Territory size shows the proportion of worldwide **net exports of fruit** (in US$) that come from there. Net exports are exports minus imports. When imports are larger than exports the territory is not shown.

Common uses of trees, especially in countries that have to import

Box. 10 A HANGING PROBLEM

There was a time that people were sentenced to death penalty for cutting trees via the Black Act (UK, 1723). Rather than a war for resources it was however a class warfare. The rich ones used the forest to go deer hunting and unrestricted tree cutting in "their" commons, while the poor ones were allowed to pick the deadwood.

In the archaeological museum of Dublin I read under the heading "sovereignty & fertility": *"It was the king's role to keep nature and society in equilibrium… A just ruler brought abundance, security, … an untrue king brought famine, pestilence, war, …"*.

Conclusion, already long ago it was known environmental responsibility doesn't work without social justice. Why are we still stuck here? According to Beddoe *et al.* (2009) a socio-ecological regime shift is needed, where we deeply change the way we view and interact with our surroundings.

And the wind shall say "Here were decent godless people;
Their only monument the asphalt road
And a thousand lost golf balls."

T.S. Eliot (Choruses from the rock, 1934)

Let‘s continue our work!

Research wish list

- Same study for French, German, Spanish, Russian, Chinese literature > commonalities & specificities compared to the results of this study and among each other
- Study on the interaction socio-economy, forests, well-being focused on (a) the polar and montane forests and (b) the dry forests > (i) really less research or minor representation in this review due to inclusion criteria? (ii) Are these „marginal“ forests also of marginal importance compared to (sub)tropical and temperate forests for human well-being?
- Study on the impact of other woody plants and growth forms (shrubs, bamboo, palms), in comparison to imported forest products, on human well-being in tree-less or tree-sparse regions > (i) are trees really needed for well-being? (ii) what can we learn about efficient forest use and forest/tree alternatives?
- Study on the impact of foreign land use (directly via forest product import or indirectly via forest conversion) on the well-being of importing ánd exporting countries
- Study on the impact of forest type and forest health on human well-being, incl. health
- Study on the effect of trade on forest type (diversity & authenticity) and forest health (going further than forest health in North America)
- Study on the dependence of high income countries on trees for food and income > are they really less dependent on trees (as review shows) or only indirectly which resulted in no/little research attention?

! Answer setting

The future looks promising. Research on forests in relation to socio-economy and well-being steadily rose during the study period and the potential to transform negative impacts of land use and income on forests into positive ones was shown to be high.

The main finding of the study, however, was a serious bias of the topic in the current English language literature, indexed in Web of Science. Current research is happening haphazardly, there is no systematic increase of our knowledge. We need to find a balance between academic freedom and academic responsability to help solving societal problems.

THOUGHT:	What would happen if we group universities around big research questions with each univers*e*-city representing all continents? Wouldn't the in-house multi-disciplinarity of universities and the diversity in world views to tackle research questions lead us to a leaner science enterprise, where both scientists and their "clients" thrive better?
VISION:	How balance the management of socio-economy & forests for the well-being of all?
PROJECT ANSWER:	Research on the interactions between socio-economy, forests and well-being is biased towards moist forests in the (sub)tropical and temperate zones, studying effects of different forest uses, focusing on developing countries in Asia.
FUTURE APPROACH:	Fill the gap on dry forests and forests in polar and mountain regions. Put together researchers working on the same topic but understanding different languages to bridge the language gap in information access. Focus on forest health and forest type, in interaction with socio-economy and well-being.

And we never give up

Finale

Being aware of the limitations of the study and that more information could be hiding in the form of non-English literature and literature not indexed in the database used, the following conclusion is made.

A major part of the research on forests in relation to socio-economy and certainly well-being was focused so far on the different ways forests are used. **Interest in the effects of forest type remain surprisingly meager**. How is it possible we didn't explore yet the various sets of benefits that different forests can bring us? Look at the diversity of trees. Will their contribution to well-being be the same?

While forest health got a bit more attention than forest diversity and authenticity, our knowledge on this topic is nearly exclusive to North American forests. This brings us to the finding that **local action is needed,** *with* **a global view**. The ways forest interact with well-being and are influenced by socio-economy are different in developing and high income countries but the study showed as well the impact of foreign land use.

The Earth Statement, a hot list of actions to prevent climate change disasters, starts with the following saying: *„2015 is a critical year for humanity. Our civilization has never faced such existential risks…"* (Earth league, 2015). Also here the bias towards science from a western perspective is screamingly loud (*cf*. Table 8). For a big chunk of humanity, 2015 is not more life threatening than any other year.

Enormous variation in trees > all same impact on well-being?

It is time to **redefine efficiency**. We are too focused on efficiency in the sense of fast and high produce in an as easy and cheap way as possible. This is however not always to the benefit of life quality for all. Just think about our use of electrical appliances and cars, which have brought us good things but also many Western diseases. We should strive to efficiency in the sense of a stable produce under changing conditions and stimulating life and people in all their diversity. Taking a phrase of Sabate & Soret (2014) "Back to the future!". My history teacher always said „l'histoire se répète" (history repeats itself) and maybe he was right and we should recycle and try out some vintage management practices. Commercial harvesting wastes 50-60% of the tree mass and as forests compete with agricultural land, also here the huge opportunity should be grabbed to reduce post-harvest losses. Before, crop residues were used for many things, among others for making paper (Smil, 2012)!

Let's keep on going, for a **suNstainable life**, where everyone has the chance to get enlightened and to lighten up his or her life.

Science sans conscience
n'est que ruine de l'âme
Là où croît le péril
croît aussi ce qui sauve

H. Reeves unifying
F. Rabelais & F. Hölderlin

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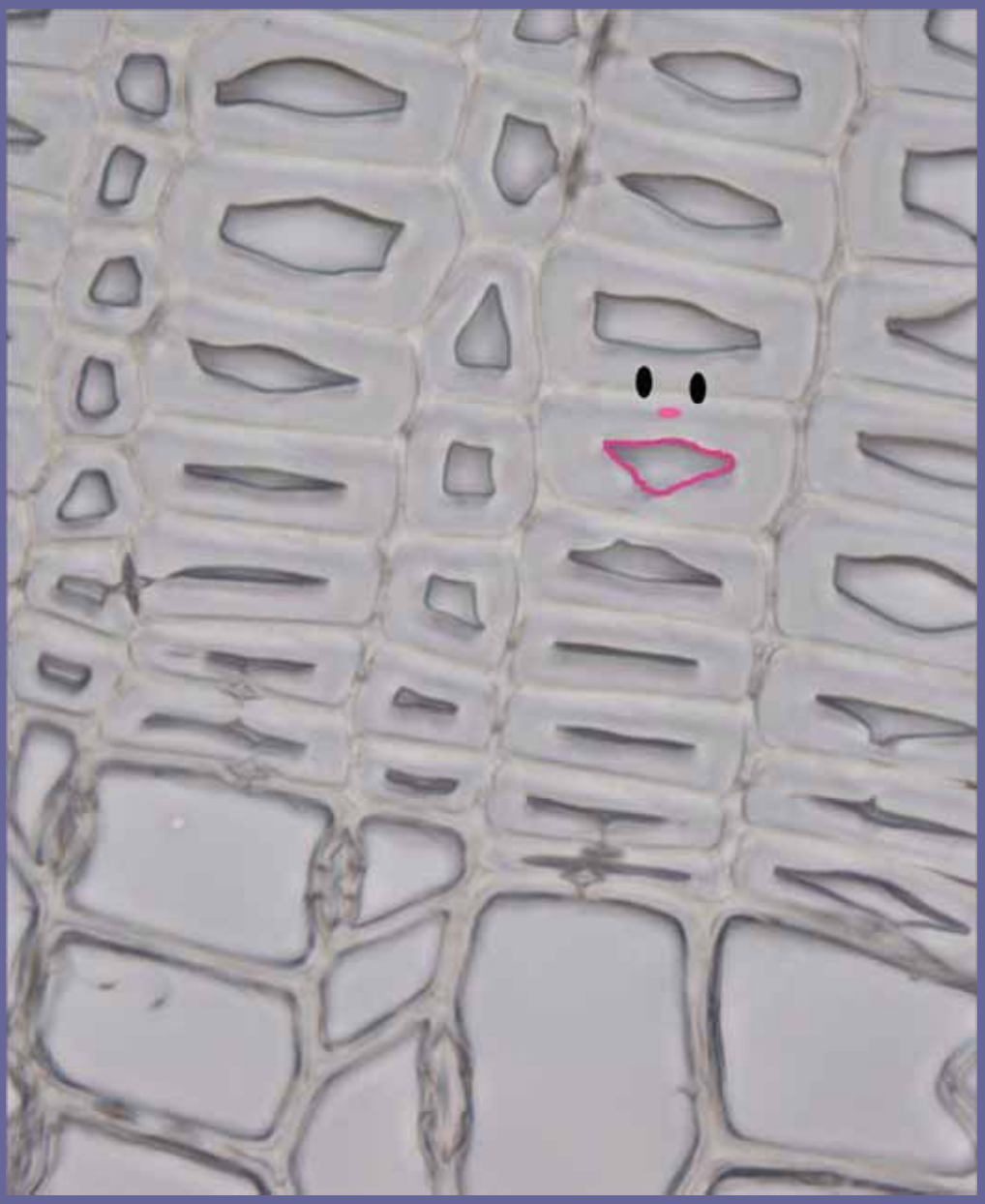
Nele schmitz
nschmitz2282@gmail.com

Picea abies microsection



Beauty in the world