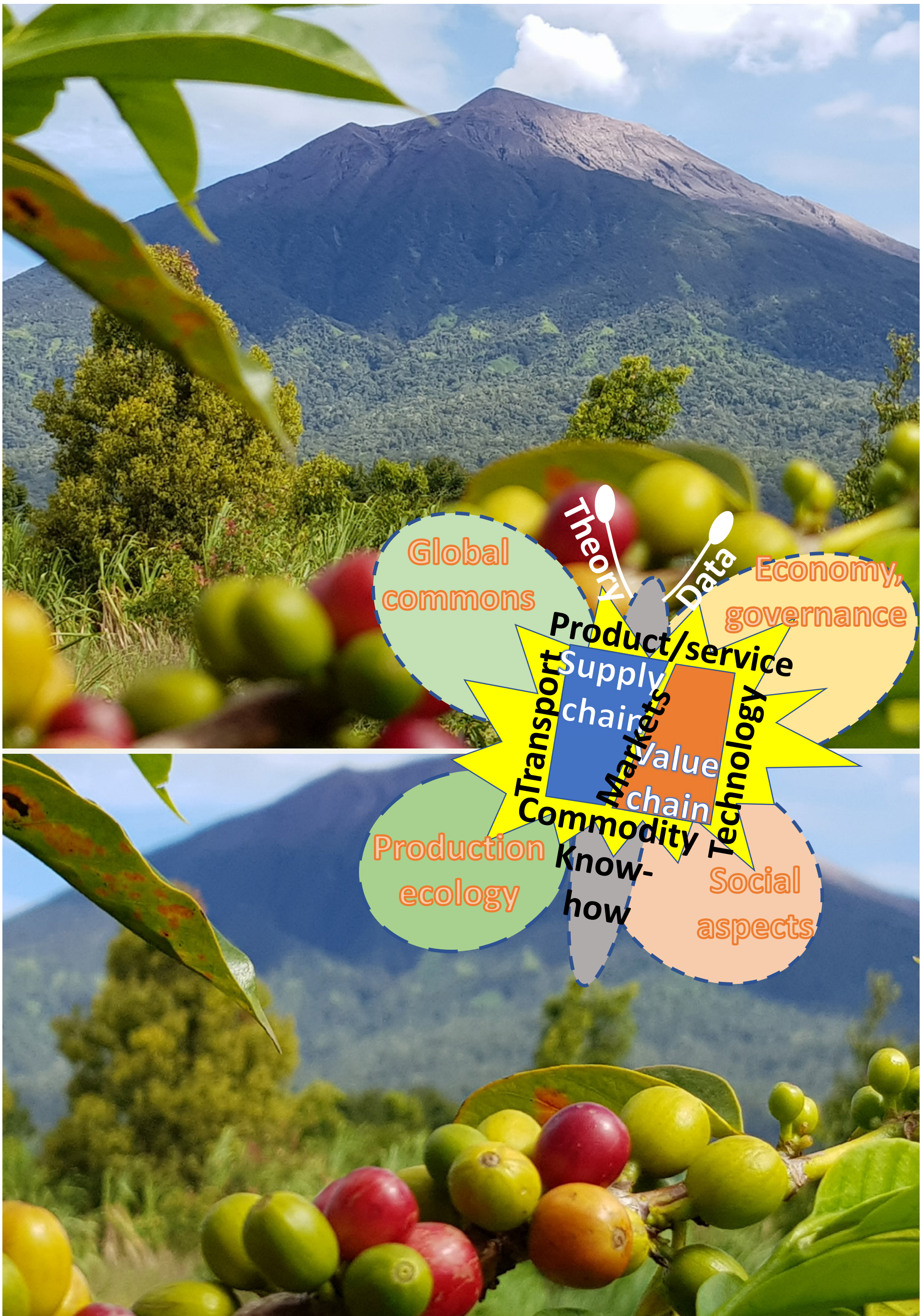


Shifting focus from the coffee berries as such to the landscape and livelihoods of producers

Photo credit: World Agroforestry/Meine van Noordwijk

CHAPTER 3

Concepts and methods for changing value chains: innovative tree-crop-based agroforestry systems

Meine van Noordwijk

Highlights

- Typologies and theories of place are needed to understand and diagnose contexts for current options of agroforestry practices as part of production systems
- Tree crop commodities connect local to global social-ecological systems, requiring cross-scale analysis of value chains
- Concerns of consumers at the end of the chain are modulated by the intermediate actors and only indirectly connected to producers at the start, and vice versa
- Understanding of current multi-scale and poly-actor processes of changing values is essential for effective innovation and theories of induced change
- Many disciplinary concepts and tools can be used to further understanding the larger system of changing values in value chains.

1. Introduction

This book deals with '***value chains***' and '***value change***' – similarly sounding words that are not often used in combination. Value chains describe a stepwise transformation of A) land to vegetation that supports harvestable yield, B) use of land, labour, knowledge and inputs to harvest raw materials, C) convert raw materials to tradable (standardized) commodities, D) make branded products out of commodities, E) provide appreciated services, and possibly to F) create unique and lasting experiences. A standard example describes coffee beans in each step of this chain, often crossing borders in the process. Along the chain the volume gets reduced, by selection of high quality components, losses due to transport or storage, and/or wastage due to logistic limitations. This reduction in volume is more than compensated by the increase in price per unit active ingredient. The way the net (volume time price, minus costs

van Noordwijk M. 2021. Concepts and methods for changing value chains: innovative tree-crop-based agroforestry systems. In: Minang PA, Duguma LA, van Noordwijk M, eds. 2021. Tree commodities and resilient green economies in Africa. Nairobi, Kenya: World Agroforestry (ICRAF).

of acquisition, processing, transport and wastage) surplus of value to the next step in the chain is shared between the partners involved depends on power, existing institutions and individual negotiation skills. Typically, farmers at the start of a value chain get only a small share of the net surplus as part of their farmgate price, as they can be interchanged for others, while traders and processors may hold monopolies (or monopsonies) and claim larger shares. Changing existing value chains (innovation) is generally done to obtain a larger share of an increased (or at least not smaller) pie. Innovations can be technical in nature (e.g. yielding more volume per unit land, or new ways of converting raw materials to branded products), social (e.g. farmer groups with grading skills and greater value capture)

Agroforestry with a strong market-oriented component of tree crops but also supporting local agroecosystem functions can be analysed and understood in multiple ways, building on many disciplinary traditions and using their terminology and concepts (Figure 3.1). Core of the current interest are the supply and value chain relations that transform and transport a farmgate 'commodity' to a (branded) product or service that consumers, close by or far away, trust and pay for. These relations are possible where production ecology and social aspects of farming allow the primary products to be harvested. Land use and cover change for this production has consequences for local and global commons of healthy landscapes, water and atmosphere, and all subject to economic rationales and poly-scale governance. Innovations can be sparked by 'issues' in any of these parts, and may have desired or undesired side-effects on others, often requiring and inducing further innovations elsewhere in the system.

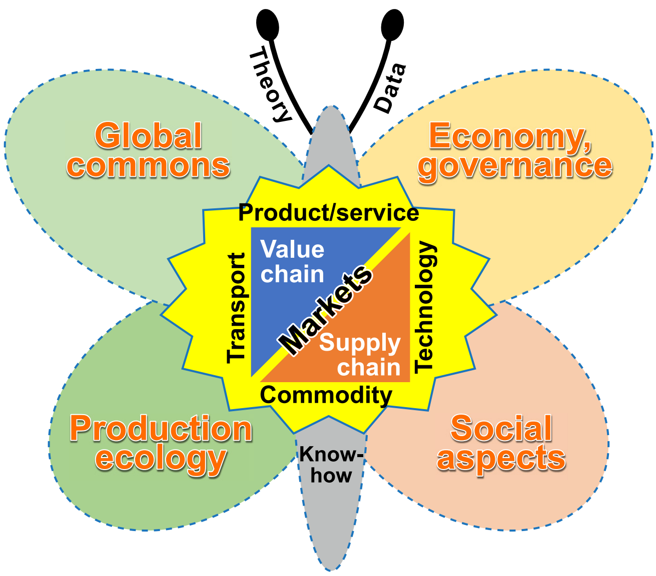


Figure 3.1: *The main aspects that contribute to a 'systems' understanding of African tree crop commodity production and value addition: two of the wings are primarily ecological-technical, two are social-economic; the back wings are local, the front wings global in nature; the body at the centre of the diagram*

In system dynamics 'butterfly effects' are known for their unpredictability and the way positive feedback loops can lead to large and far away consequences of what started off as a butterfly clapping its wings. We can't expect full predictability to emerge, but a systems approach that analyses the components and their interactions and synthesizes dynamic understanding can help in drawing lessons from the past and being better prepared for multiple futures.

Characterization of context and choices, plus understanding relationships and feedbacks is essential for appreciating 'options in context' and the way these change over time. Beyond observer roles, active engagement as agent of induced change to help make the world a better place has since long been the ambition of advocates of agroforestry. As a background to such endeavours, a recent publication (van Noordwijk, 2021a) introduced more than one hundred aspects, visually and with a short text, providing references to more specialized literature. In this chapter a selection will be presented (Figure 3.2).

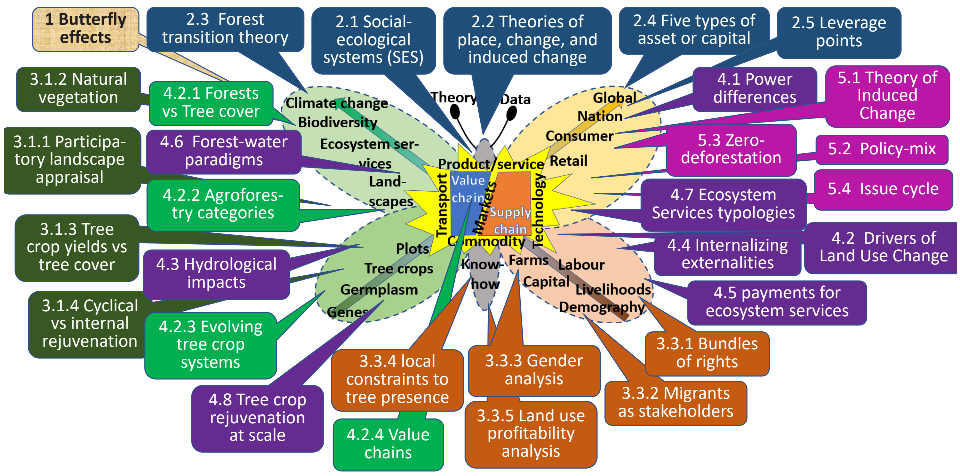


Figure 3.2: *Overview of the concepts and methods touched on in this chapter*

Aspects include: A) Characterization of structure in existing land use can lead to a Theory of Place (ToP: patterns answering what?, where?, who? questions), B). Diagnosis of functions influenced by changing practices and systems can lead to a Theory of Change (ToC: patterns in answering how?, why?, since when?, so what? and who cares?), C). Assessments of leverage points for adaptive, transformative and re-imaginative change can lead to a project-design Theory of Induced Change (ToIC), D) Research methods for ecological, agronomic, social, economic and policy-oriented research require clarity on units of analysis and scale relations of observable properties in relation to questions and hypotheses, E) Guidance on how research methods need to match the stage of public issue cycle debate to contribute to policy reform.

2. Social-ecological systems (SES)

2.1. Cascade model

A Social-ecological (SES) approach aims to understand interactions between structure, function, services, benefits, value, decisions, and management in a 'cascade' model, with feedback (Figure 3.3; Namirembe et al 2017).

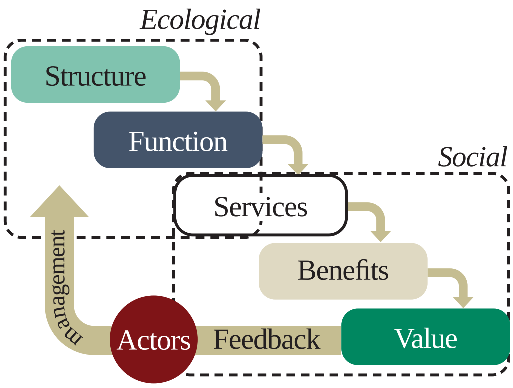


Figure 3.3: *The cascade model of social ecological system interacting with ecosystem services*

2.2. Theories of place, change, and induced change

Who?, what?, where? as the basic questions of a **Theory of Place** (ToP) form the basis for understanding dynamics of land use in **Theories of Change** (ToC), that are an essential building block for **Theories of Induced Change** (ToIC), that focus on bringing Goals into reach by targeted interventions (Figure 3.4; van Noordwijk et al 2013b, 2015).

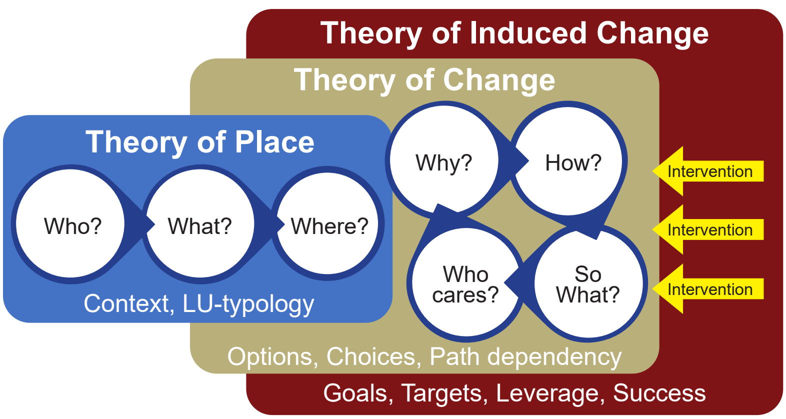


Figure 3.4: *Leading questions to understand context, options and choices*

2.3. Forest transition theory

Useful as framing for describing spatial patterns of context, but also dynamic processes of change, the forest transition theory provides a basis for pantropical comparative analysis (Figure 3.5; Dewi et al 2017).

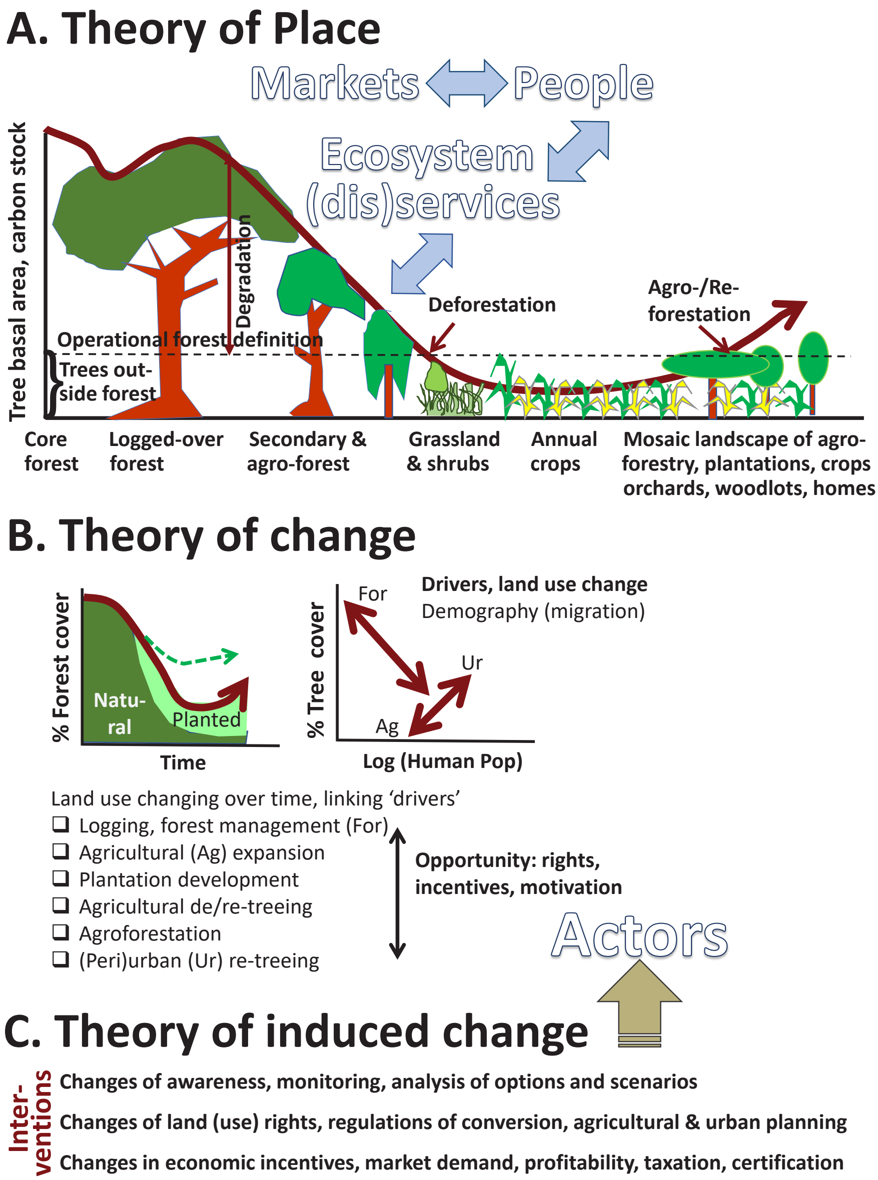


Figure 3.5: *Three interpretations of forest transition theory*

2.4. Five types of asset or capital

… are used in the production of goods and services, depleting or increasing capitals at different rates. It can be seen as converting one type of capital (e.g. natural) into another (e.g. human or infrastructural); conversion typifies scale transitions to national and global scale (Figure 3.6; Bebbington 1999).

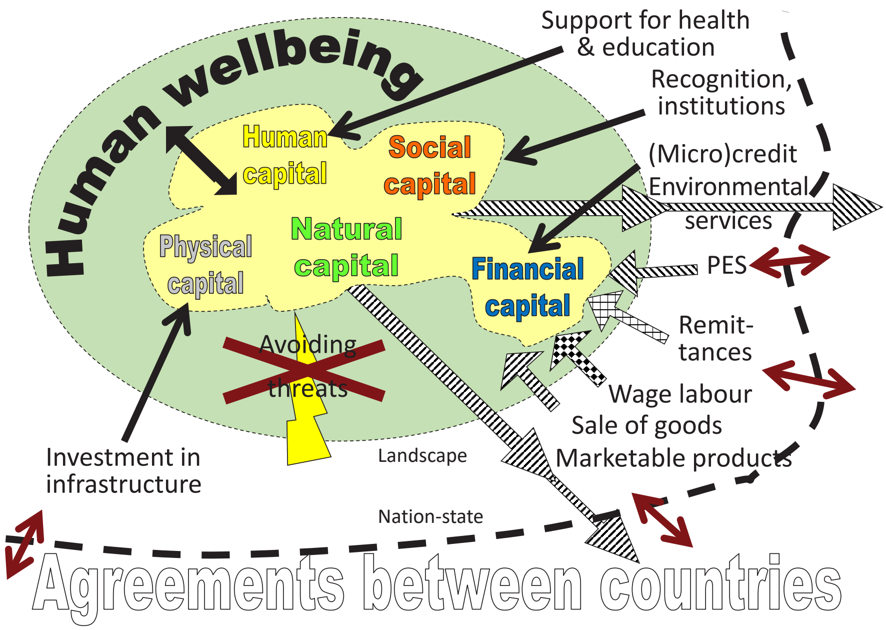
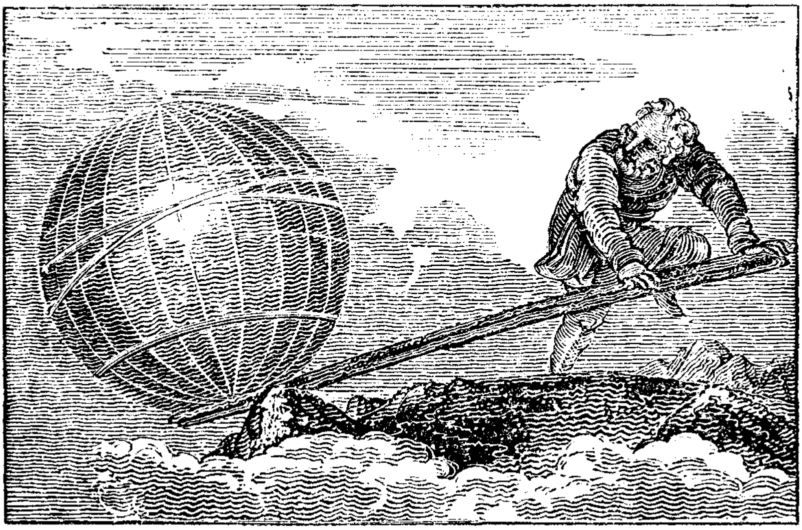


Figure 3.6: *Five asset types in local interaction with the outside world*

2.5. Leverage points

"Give me a stick (lever) long enough and a fulcrum on which to place it, and I shall move the world" -- a statement attributed to the Greek inventor Archimedes (287-212 BC in Syracuse) the greatest scientist (mathematician physicist, engineer, astronomer and military adviser) of his time, has been visualized since at least 1824 as in Figure 3.7A. Lifting the world is possible by a relatively small force at a large distance, if the fulcrum (turning point) is solid, the stick strong and effectively connected to the world. Accepting this visual image as 'meme', the concept of 'leverage' has become a model of change in complex, adaptive systems. Based on experience in constructing and using 'system analysis' and 'models', Meadows (1999) proposed a hierarchy of 'leverage points' (Figure 3.7B).

A.



B. Twelve places to intervene in a system (in increasing order of effectiveness in changing its dynamic properties):

Places to intervene	
12. Constants, parameters, numbers (such as subsidies, taxes, standards, data)	Inventories, Theories of Place
11. Sizes of buffers and stabilizing stocks relative to associated flows 10. Structure of material stocks and flows (such as transport networks, population age structure) 9. Lag times and time of delays, relative to the rate of system change 8. Strength of negative feedback loops, relative to the impacts they are trying to correct against 7. The gain around driving positive feedback loops 6. The structure of information flows (who does and does not have access to what kinds of information)	Dynamics, Theories of Change
5. The rules of the system (such as incentives, punishments, constraints) 4. The power to add, change, evolve, or self-organize system structure 3. The goals of the system 2. The mindset or paradigm out of which the system (with its goals, structure, rules, delays, feedbacks and parameters) arises 1. The power to transcend paradigms	Dynamics, Theories of Induced Change

Figure 3.7: *Leverage points in dynamic systems: A. The* [Archimedes meme of 1824](), *B. The hierarchy of interventions in dynamic, adaptive systems based on Meadows (1999)*

3. The Who? What? Where? of land use as Theory of Place (ToP)

3.1. Ecological Science-based perspectives on landscapes as part of a ToP

3.1.1. Participatory Landscape Appraisal

… aims to compare, contrast and where possible reconcile three perspectives: one based on local knowledge, a second through the lens of public policies and as a third a science-based view. Landscapes are based on the abiotic background, vegetation, flora and fauna, and are shaped by human modification of land cover in an institutional context, constrained by rights, markets and impacts, providing goods and services (Figure 3.8; Hoang et al 2013).

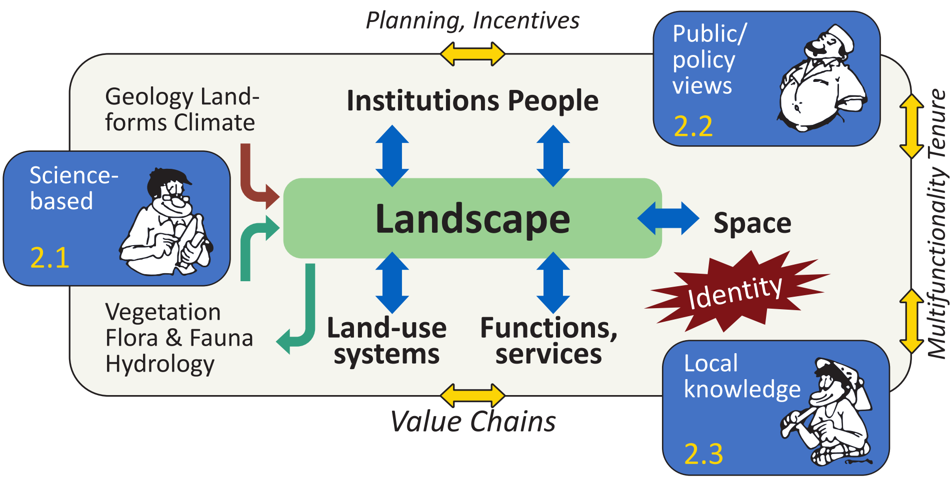


Figure 3.8: *Landscape across three knowledge systems*

3.1.2. Natural vegetation

… varies with latitude, elevation, topography and is subject to human modification, potentially along a tree cover or forest transition trajectory; vegetation typology can be purely based on vegetation structure, but often incorporates elements of the other determinants (Figure 3.9; Creed and van Noordwijk, 2018).

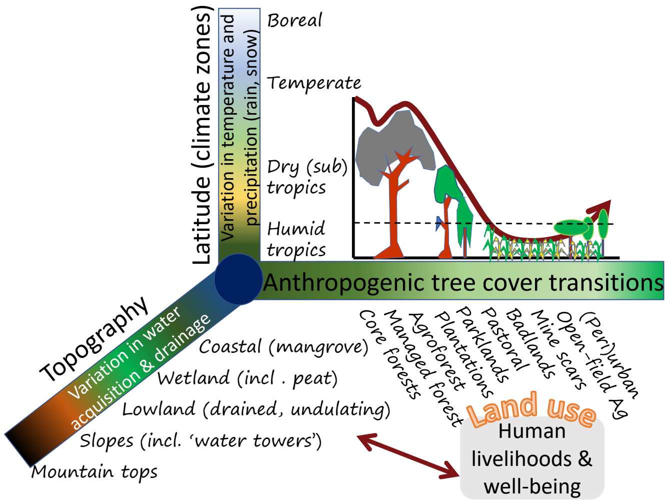


Figure 3.9: *Three axes along which vegetation varies: latitude, topography and human influences*

3.1.3. Tree crop yields vs tree cover

Optimum shade (Figure 3.10) depends on context (Beer et al 1997, Tscharntke et al 2011), including various pest and disease pressures.

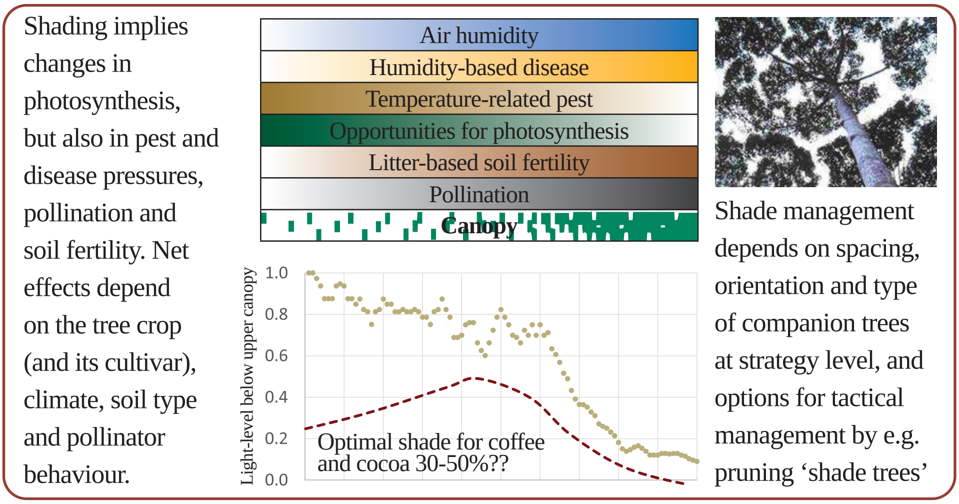


Figure 3.10: *Optimum shade?*

3.1.4. Cyclical vs internal rejuvenation ('sisipan')

Agroforests such as 'jungle rubber' reflect two types of forest management: gap-level (underplanting) or whole-field (even-aged); if burning is not allowed, food crops are skipped (Joshi et al 2000, Xu and Yi 2012); Figure 3.11).

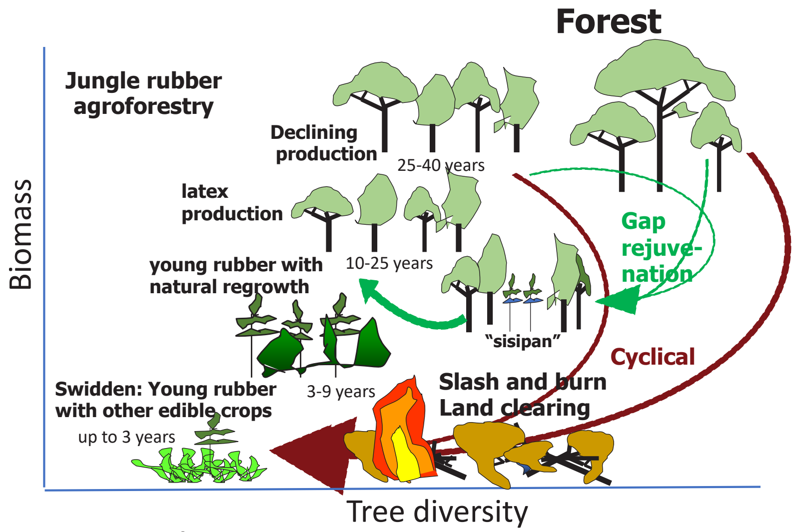


Figure 3.11: *Rubber life-cycles*

3.2. Social and policy perspectives on land and landscapes as part of a ToP

3.2.1. Forests vs Tree cover.

Two different angles are on **forest** as **vegetation (or tree cover as metric)**, and forest as **institution** imply that 'deforestation' can mean the loss of tree cover and/or the transfer to other institutional domains (van Noordwijk and Minang 2009, Purwanto et al 2020; Figure 3.12).

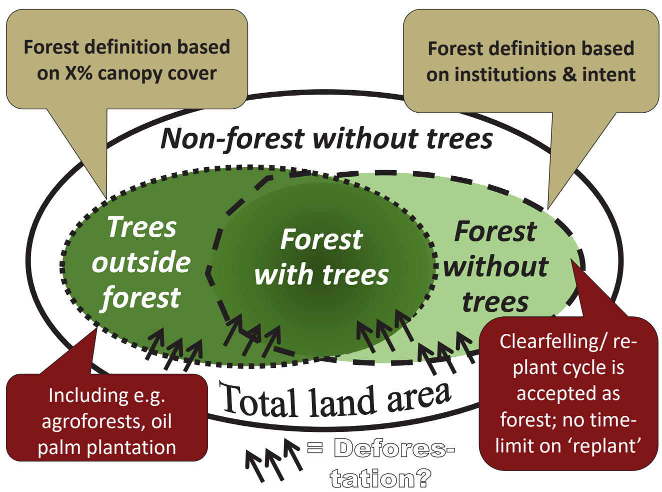


Figure 3.12: *Forest definitions in relation to tree cover and institutional concepts*

3.2.2. Agroforestry categories

Distinguish 'monoculture', simple and complex agro-forestry systems, and complex, mixed agro-forest (the latter usually are 'multistrata'), based on tree diversity and relative share of the main tree in the total basal area (Joshi et al 2013, Sari et al 2020; Figure 3.13)

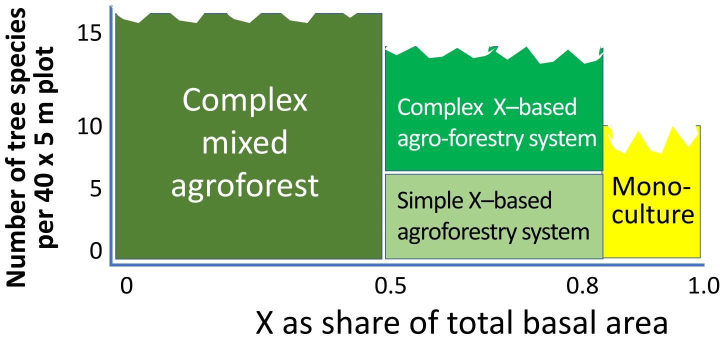


Figure 3.13: *Agroforestry categories defined*

3.2.3. Evolving tree crop production systems

Derive from four types of preceding land uses, providing multiple interpretations of 'deforestation' and 'restoration', but also influencing soil and vegetation (Martin et al 2020; Figure 3.14).

Four origins for four modes of tree crop cultivation:

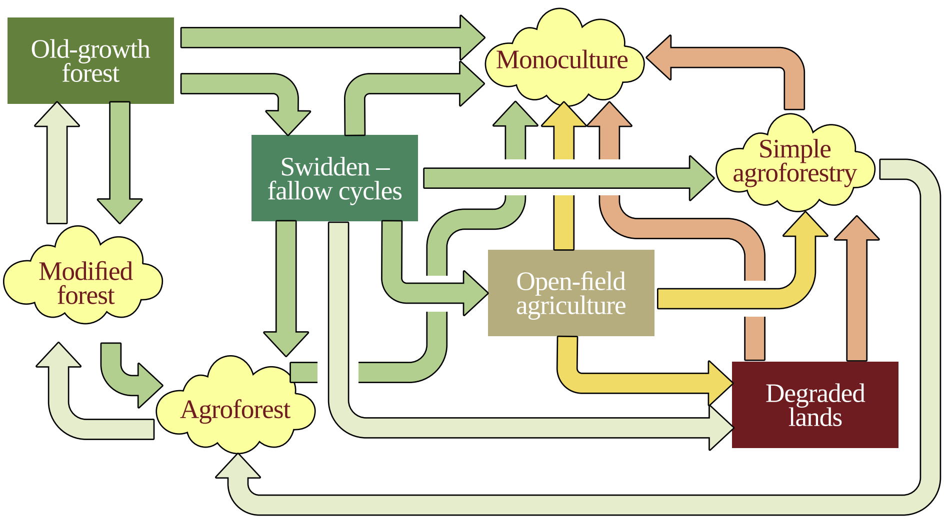


Figure 3.14: *Land use change trajectories of tree crop cultivation*

3.2.4. Value chains

Within supply chains value changes and so do prices per unit volume, as analysed under the ‘value chain’ concept, with coffee as classical example (Kaplinsky and Morris, 2000; Figure 3.15).

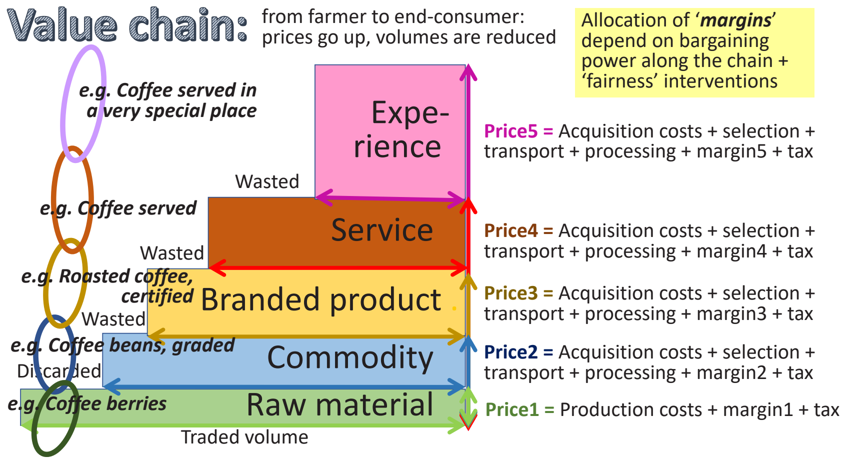


Figure 3.15: *Coffee value chain*

3.3. Social stratification as part of Theories of Place

3.3.1. Bundles of rights

… that defines ‘tenure’, expanding on the five aspects in the seminal study by Elinor Ostrom and colleagues (Galik and Jagger 2015; Figure 3.16).

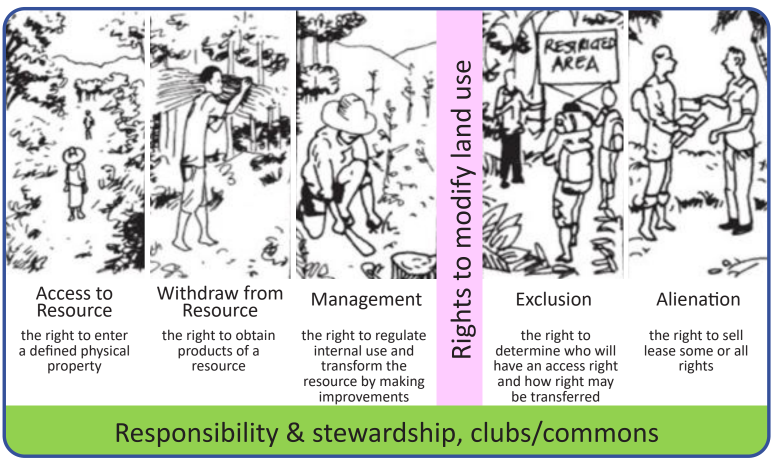


Figure 3.16: *Unpacking tenure as bundle of rights*

3.3.2. Migrants as stakeholders

linked to tree crop production landscapes and their markets are easily overlooked where **migrants** interact with local elites on land acquisition and with large-scale plantations as labour force (Galudra et al 2014). When right-holders are distinguished as subset of stakeholders, migrants are differentiated from those born into local communities, depending on how they were assimilated into local institutions (Figure 3.17).

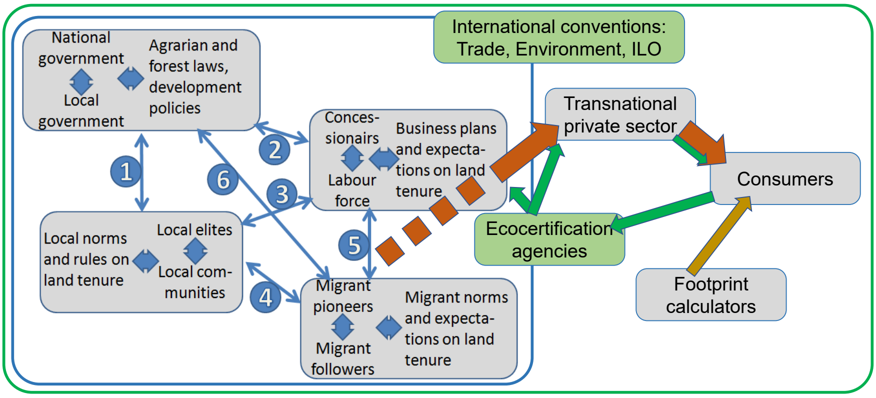


Figure 3.17: Stakeholder interaction in tree crop production

3.3.3 Gender analysis

... of land use practices needs to consider the way work (effort), benefit (net of costs), inheritance rules and control (decision-making) are distributed over male and female household members, according to male and female informants. Specific inheritance rules can apply to land, trees, livestock (Mulyoutami et al 2013; Figure 3.18).

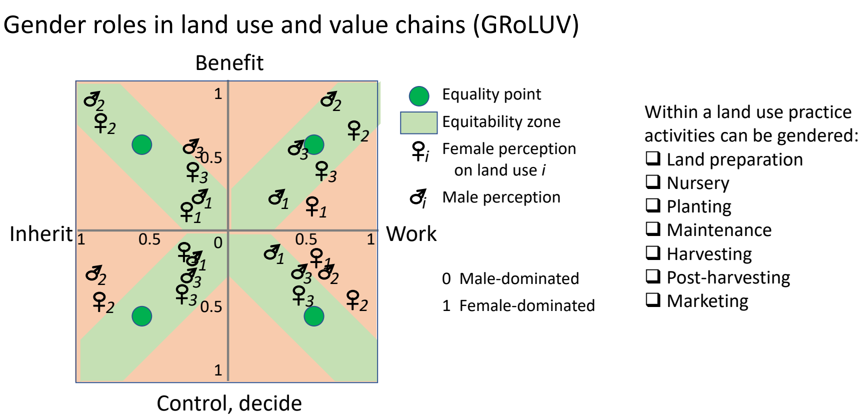


Figure 3.18: Four dimensions in gender analysis of agroforestry

3.3.4. WhyNoTree analysis of local constraints to tree presence

On–farm tree presence and/or diversity varies with context. There are some valid reasons (#6, #7) for lack of interest by specific farmers in trees, but many reasons, if emerging as important in a local context, can lead to remedial actions (van Noordwijk et al 2013a; Figure 3.19).

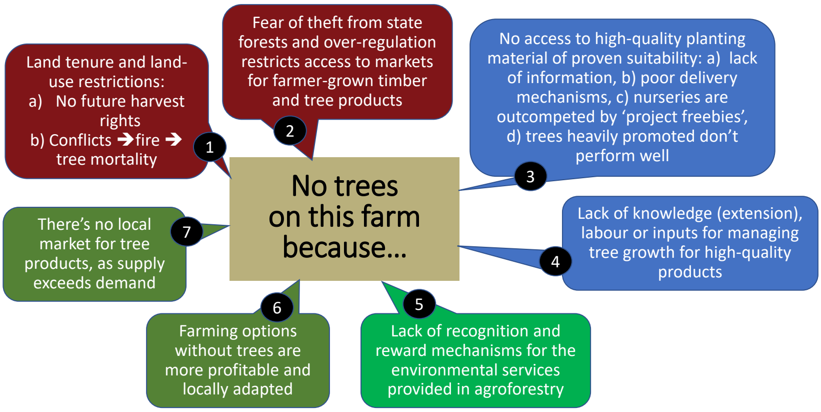


Figure 3.19: *Multiple reasons for lack of trees, to be diagnosed locally*

3.3.5. Land use profitability analysis

… uses the toolbox of agricultural economics to convert technical descriptions of inputs and outputs over the life-cycle of a production system into (discounted) cash flow (Rahmanulloh et al 2013; Figure 3.20)

Land use profitability analysis (LUPA)

Analysis of a land use practice

Year	Stage	Costs (C)	Benefits (B)
0	Land acquisition, clearing	Labour, inputs, tools	Harvest: vo-lume*price
1	Planting, weeding	*idem*	*idem*
2	Maintenance	*idem*	*idem*
3	…		
…	Harvesting	*idem*	*idem*
…	Harvesting	*idem*	*idem*
n	Final harvest	*idem*	*idem*

Net Present Value (NPV):

$$NPV = \sum_{t=0}^{t=n} \frac{B_t - C_t}{(1+i)^t}$$

Where I is the discount rate

Returns to labour (R2L): wage rate at which NPV=0

Years to positive cash-flow first year with NPV sum >0

Figure 3.20: *Land use profitability analysis*

4. The So what?, Who cares?, and Why? of a theory of change (ToC)

Processes, feedbacks and functioning of social-ecological systems shape a Theory of Change.

4.1. Power differences

… along a DPSIR chain, are the focus of a political ecology/ economy analysis of land use change (Svarstad et al 2008, van Noordwijk 2013; Figure 3.21).

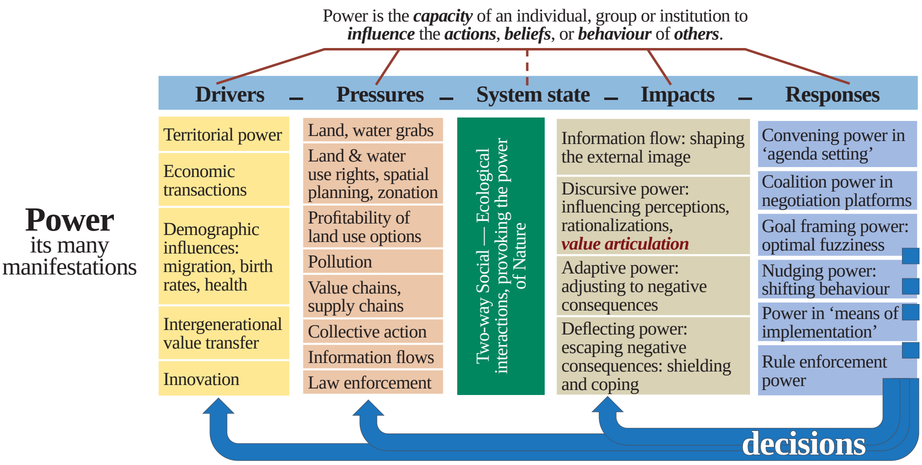


Figure 3.21: *Power differences expressed along a Drivers-Pressures-System state- Impacts-Responses (DPSIR) chain*

4.2. Land Use drivers as explanatory factors

… for participatory assessment of land use change and its drivers (van Noordwijk 2013; Figure 3.22).

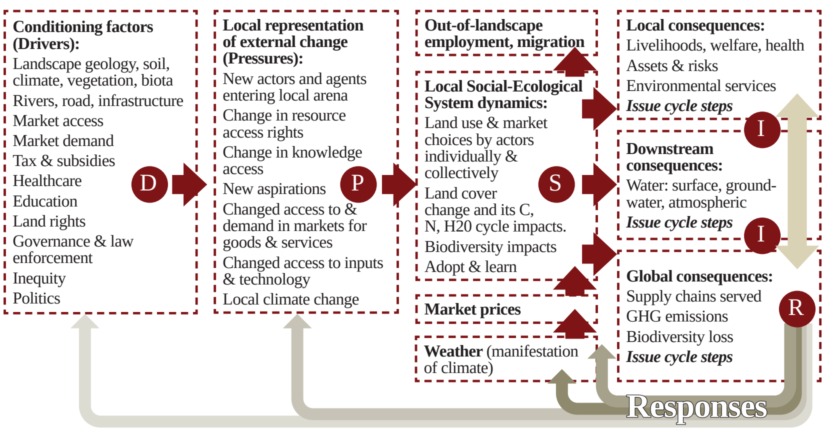


Figure 3.22: *Explanatory factors for local Social-Ecological System dynamics, based on a DPSIR typology*

4.3. Hydrological impacts

… of land use change, including decreases and increases in tree cover, depend strongly on the position in the landscape where the changes occur (van Noordwijk et al 2020; Figure 3.23).

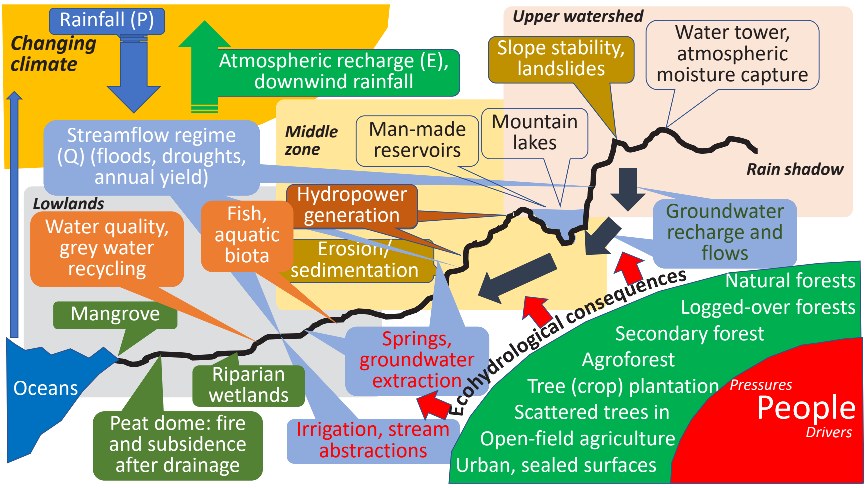


Figure 3.23: Landscape connectivity between land use effects on hydrological cycles

4.4. Internalizing externalities

Human brains are wired to make decisions, not to ponder about all possible side-effects on every other part of the world – but sometimes such effects, ignored as 'externalities' can come back to haunt us. Attempts to 'internalize' such externalities have to guard against making decisions too complex – but in their simplification they shift the borders of externalities, not eliminate them (van Noordwijk et al 2012, van Noordwijk 2021b; Figure 3.24).

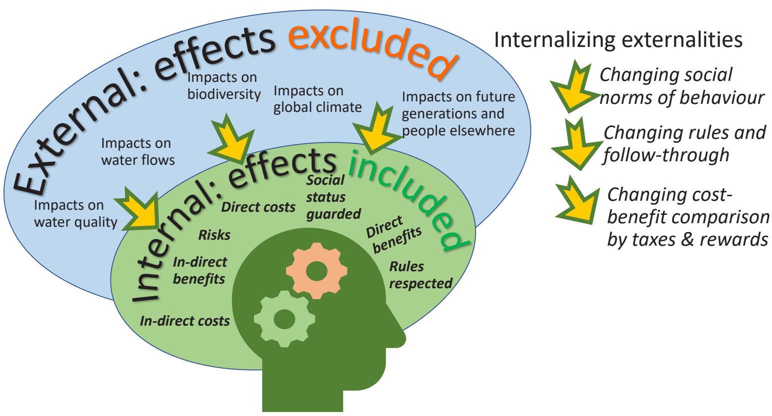


Figure 3.24: Internal effects included and externalities excluded in human decision making

4.5. Three paradigms within the 'payments for ecosystem services' (PES) umbrella

… are Commodification (CES), Compensation (COS), Coinvestment (CIS) (van Noordwijk and Leimona 2010, Wunder 2015; Figure 3.25).

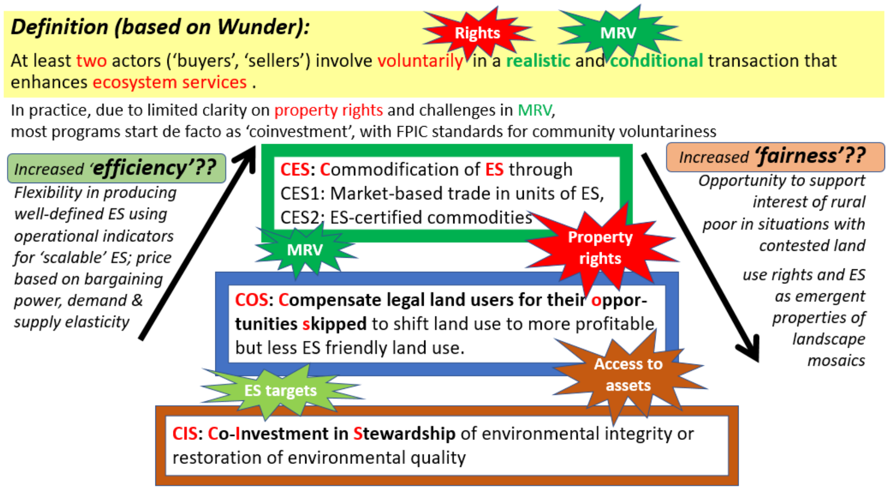


Figure 3.25: Three paradigms within payments for ecosystem services in tropical landscapes

4.6. Three forest-water paradigms shape policy responses

… as simplified guidance suggests that either tree planting is a universal solution, a risk for downstream water users, or an activity that needs to be understood in its local context with scale-dependent answers (van Noordwijk et al 2018; Figure 3.26).

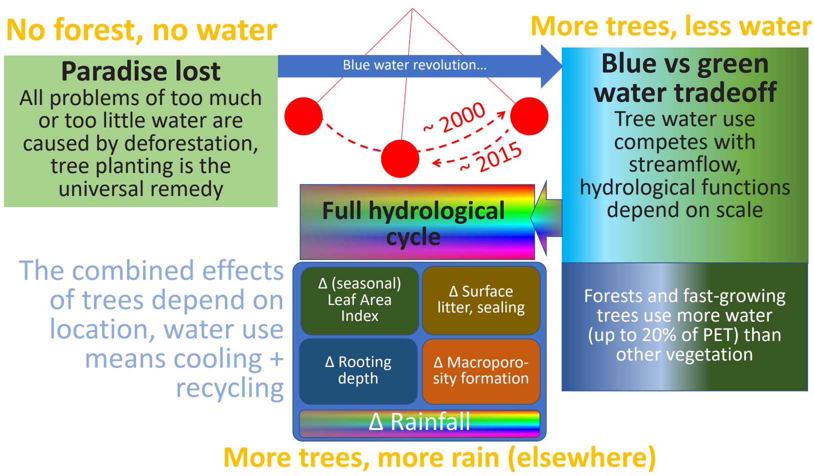


Figure 3.26: Three perspectives on the forest-water relationship, linked to 'colours' of water

4.7. Ecosystem Services typologies

relate 'ecosystem function' to various types of human benefits (provisioning (p), regulating (r), cultural (c), supporting (s)) (van Noordwijk et al 2016; Figure 3.27).

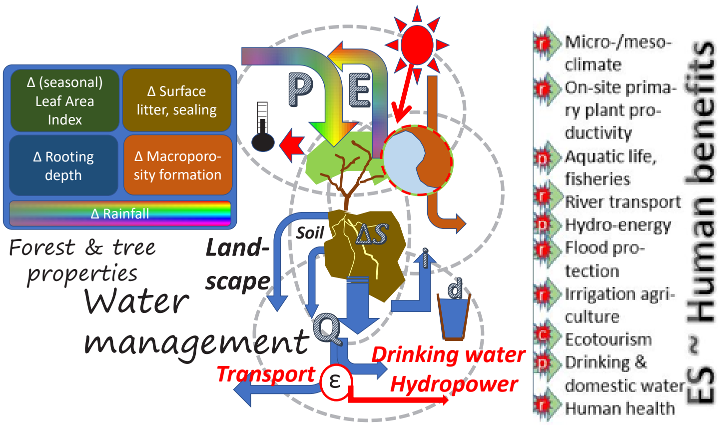


Figure 3.27: *Scale-dependence of multiple interacting water-related ecosystem services*

4.8. Pathways for tree crop rejuvenation reach across scales

While large-scale plantations may plan for a rotation with replanting at the end of a cycle, paid for by current production elsewhere, smallholders generally have not been able to save for such and are dependent on external support, often in the form of government programs and subsidized loans. There is, however, an alternative in the mixed-age agroforestry system that are managed at tree, rather than field, level and in which risks are manageable; top-working and *in situ* grafting can be applied to coffee and various other fruit trees (Vaast et al 2016; Figure 3.28).

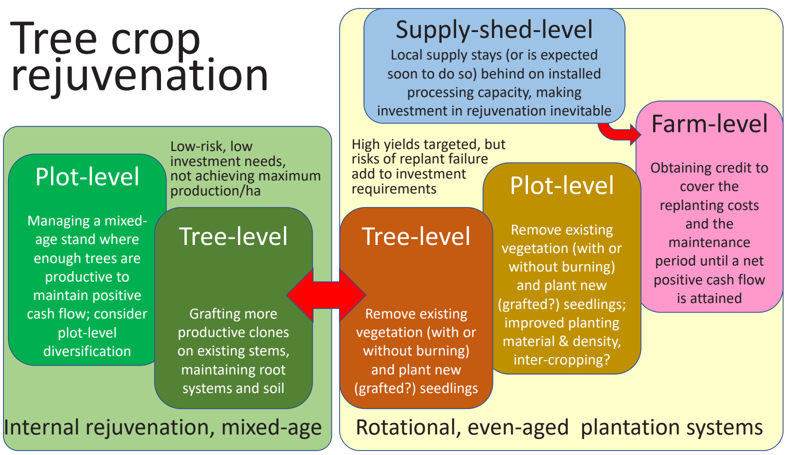


Figure 3.28: *Multiple ways tree crop rejuvenation can be approached in supply and value chains*

5. Leverage points for a Theory of Induced Change

5.1. Leverage points for a Theory of Induced Change (ToIC)

… can focus on adaptive, mitigative, transformative and/or re-imaginative change that targets various steps in the DPSIR cycle, interacting with five steps in an issue/decision cycle (van Noordwijk et al 2020; Figure 3.29).

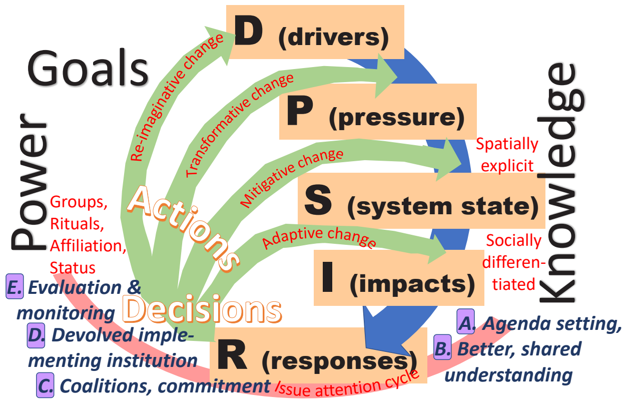


Figure 3.29: *The DPSIR cycle as basis for adaptive, mitigative, transformative and re-imaginative change*

5.2. Understanding a 'policy-mix'

In which aspects of regulation, incentives and motivation are designed with single policy objectives in mind, but jointly influence citizen decisions and choices, with risks of 'perverse incentives' and potential synergy (Leimona et al 2018)

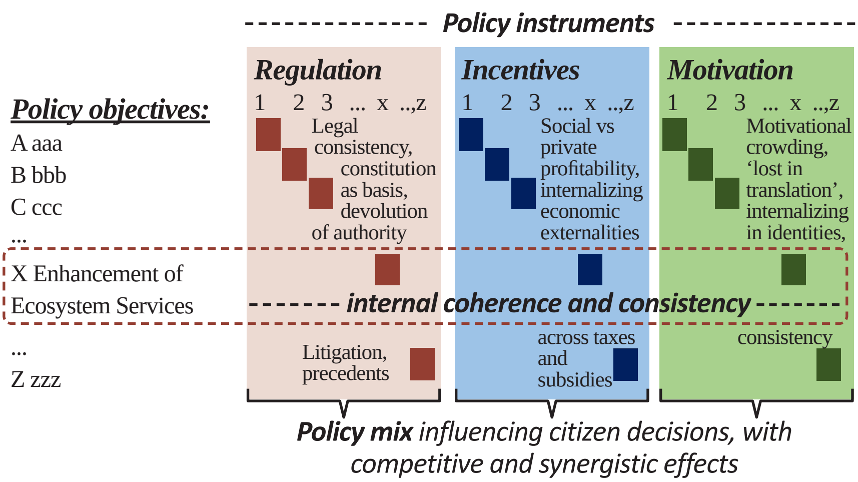


Figure 3.30: *Policies tend to be developed in response to 'hot' issues, but interact with many other policy objectives, and often contradictive use of policy instruments*

5.3. Zero-deforestation commitments

… are more easily made than transparently implemented. The higher the 'forest' threshold used, the less impactful the commitment is, as it allows conversion of 'degraded' forest (Garrett et al 2019).

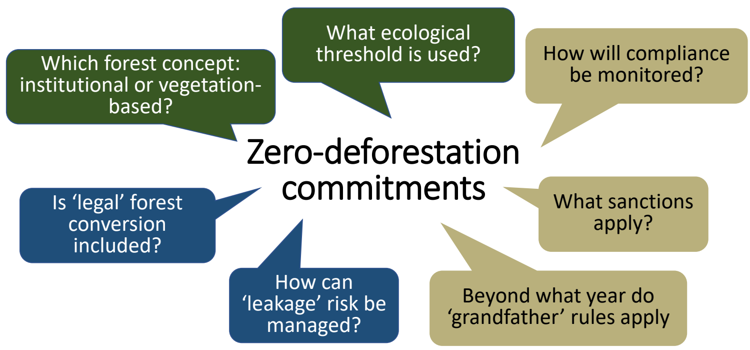


Figure 3.31: *Aspects of zero-deforestation commitments in tropical tree crop commodity supply chains*

5.4 The shamrock issue cycle

Identifying, addressing and overcoming the four types of constraint to effective, fair and sustainable solutions to emerging issues is like searching a four-leaved shamrock (Figure 3.32).

Figure 3.32: *Four interacting stages of public policy issue cycles, with bottlenecks to progress*

The traditional role of research is focused on leaf A only, but 'boundary agent' scientists can also contribute to the other three. Quantitative indicators for the four domains have been suggested for wider testing to characterize the current conditions around an 'issue' (van Noordwijk 2019, 2021b).

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