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Why do anti-deforestation policies succeed or fail? Review of the Theory of Change emerging from the existing literature

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Abstract

Studies addressing the effectiveness of policies aiming at combatting deforestation have produced mixed results, showing no obvious and undebated correlations between a certain type of forest policy instrument and its success in preventing or deterring deforestation. Hence, why anti-deforestation policies succeed or not still remains unclear.

This paper proposes a new reading grid of the effectiveness of anti-deforestation policies, by mapping the causal mechanisms at stake from its design to its objective of avoiding deforestation. 264 empirical evaluations are collected and reviewed in order to reveal the theory of change (ToC) that emerges from the current practice of forest policy evaluation. This mapping sheds light on the different causal steps necessary for anti-deforestation policies to be effective, and on the conditions at stake at the various stages of the causal chain, according to the existing literature. Doing so, it allows visualising the reasons for the success of anti-deforestation policies -or lack of, as per the literature corpus analysed. It also provides guidelines with regard to the elements of context to look at when designing and implementing such anti-deforestation policies. Finally, it exposes what is most researched by evaluators, as well as observes the main apparent evaluation blind spots.

Our results highlight that the effectiveness of anti-deforestation policies is context-specific on political, economic, social, cultural, environmental and structural dimensions: The political willingness, the nature of available funding, the governance structure, the existence of forest-related traditions, the social and economic situation of local populations, and the nature and spatial scale of the deforestation drivers are elements that influence the success of the policy. They may play this role at different stages of the policy design and implementation: at decision-making stage, during its implementation, or when evaluating its results and outcomes.

The majority of conditions reported from the literature concern the implementation phase, at the local level. In other words, according to evaluators, the success or failure of anti-deforestation policies mostly lies in its effective implementation in the field, i.e. in its ability to generate a social acceptance of and compliance to the policy rules. However, some studies also show that a successfully implemented policy does not avoid deforestation if the actual deforestation driver is not properly addressed, thus resulting in deforestation being displaced or unchanged. This underlines the importance of prior risk assessments and field studies to design an adapted policy instrument to combat deforestation.

Keywords

Deforestation, Forest Degradation, Forest policy, Theory of Change, Policy evaluation, Causal relations, Effectiveness, Conditions of effectiveness, Research synthesis, Research biases, Meta-database, REDD+.

JEL Codes

Q23, Q28, Q57.

1 Introduction

Although the importance of forest ecosystem services, as well as the detrimental consequences of forest loss, have been increasingly acknowledged, forests of ecological quality are shrinking globally (IPBES, 2019; IPCC, AR5, Chapter 11). Quantifications of global forest change report from 129 million hectares of natural and planted forests loss between 1990 and 2015 (FRA 2015), to 230 million hectares of gross forest loss between 2000 and 2012 (Hansen et al., 2013). Tropical forested are the most affected, with an annual cover loss increasing by 0.2 million ha every year, according to Hansen et al. (2013).

Many countries have been devoting efforts to curb deforestation and promote forest conservation. According to the latest FAO report, 96% of the world forests are now under forest policy or forest legislation. Larger land areas have been appointed for permanent forests and for biodiversity conservation (FRA 2015). Besides, since the initiative on Reducing Emissions from Deforestation and forest Degradation (REDD) was introduced on the international scene in 2005[1], policies and research studies on forest conservation have multiplied. However, while the global rate of net forest loss[2] has halved since the 1990s, highly biodiverse tropical forests continue to decline (IPBES, 2019), and evaluations of policies implemented in those areas have not consistently demonstrated their success in preventing, deterring or halting deforestation[3].

Still, a wide variety of Policy Instruments intending to fight Deforestation and forest Degradation in the Tropics (termed PIDDTs hereafter) exists. Some PIDDTs directly affect land use through restrictions, labelled as "command-and-control instruments". Other instruments exert an indirect influence through incentives conferred by "market-based instruments" and "voluntary approaches" (Lambin et al., 2014), or even educational instruments. Those different types of instruments respond to different causal mechanisms, addressing more or less direct drivers of deforestation. They might therefore respond to different logical frameworks and conditions of success, depending on different contexts of implementation.

Against this background, the hypothesis behind this paper is that shedding light on such causal mechanisms may help to disentangle the reasons behind the previously mentioned mixed-success of forest policies. This could reveal what causal steps and elements of context are necessary for PIDDTs to be effective, and which of those are common or specific to the different types of PIDDTs, targeting deforestation more or less directly.

A literature review appeared as key to reveal such causal mechanisms, as it could allow for cross-checking and going over a large set of evaluation data, concerning all types of PIDDTs and a large diversity of contexts. However, PIDDTs' causal mechanisms are little studied in the literature, as most forest policy evaluations rely on quantitative impact analyses[4]. While such quantitative analyses are essential to assess forest policy effectiveness, they generally do not allow for determining the cause-and-effect relationships behind such effectiveness – or lack of-,

[1] The Governments of Papua New Guinea and Costa Rica were first to raise this subject during the UNFCCC COP11 in 2005 in Montreal.

[2] The net forest loss refers to the global gross forest loss compensated by forest increases, mostly occurring in temperate and high-altitude forests (IPBES, 2019).

[3] Among those evaluations are e.g. Blackman, 2015; Brandt, et al., 2015; Shah and Baylis, 2015; Ferraro and Hanauer, 2011; Figueroa et al., 2009

[4] Among the most cited, up to 2015, are Pfaff and Sanchez-Azofeifa, 2004; Wünscher, Engel, and Wunder, 2008; Robinson, Albers and Busby, 2013; Pfaff, A., Amacher, G.S. and Sills, E.O., 2013; Busch, Ferretti-Gallon, et al., 2015; Sparovek et al., 2015; Börner, Marinho and Wunder, 2015, etc.

especially when results are mixed and diverse. More generally, some authors warn against the inappropriate use of experimental and quasi-experimental methods (Deaton, 2010) especially in the assessment of conservation programs (Vincent, 2015).

This suggests the need to broaden the scope of policy evaluation over quantitative impact assessments, and to proceed to qualitative systematic reviews. Such reviews may usefully complement existing quantitative meta-analyses (see e.g. Choumert et al. 2013). Therefore, the literature review chosen in this paper relies on empirical evaluations rather than quantitative impact assessments.

In our view, this was important for different reasons. One of these reasons is the inadequate uptake of policy evaluation literature in institutions dealing with science and biodiversity policies, which tend to focus on ecology and to ignore the peer-reviewed social sciences literature dealing with policies and policy evaluation. This was especially the case in some of the assessments produced by the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES) on pollinators, and more recently in its global assessment, which, in our view, did little use of the the existing policy evaluation literature (Rankovic et al., 2016). Another important reason is that forest policy evaluators, as well as evaluation users, should be better informed on the blind spots in the current coverage of the subject, as well as on already well-addressed questions (Poteete, 2008). Lastly and more generally, the field of environmental policy evaluation needs a better linkage between theoretical orientations and empirical research, as when Miteva et al. (2012: 81) stated it: "One of the major drawbacks of the current literature is that the empirical work is disconnected from theories that describe how the interventions affect outcomes".

This article proposes a new theoretical reading grid of the effectiveness of anti-deforestation policies, by mapping the causal mechanisms at stake, for different types of PIDDTs to avoid deforestation effectively. Results are based on the review of empirical evaluations of PIDDTs. Doing so, we intend to bridge the gap between empirical work and theories in the field of forest policy evaluation.

By mapping policy evaluation as currently practiced, this paper aims at revealing the theory of change (ToC) that emerges from current forest policy evaluation. The ToC of a PIDDT refers to the reasons "*why*" the policy is designed, as well as the conditions and the transmission channels to its potential outputs and outcomes ("*how*"), and to the degree to which they produce impacts (*"how much"*). It also provides indications of the success conditions of PIDDTs.

This article, therefore, intends to answer the "urgent call" among forest researchers "for more evaluations from much more biodiversity-relevant locations. (…) and to use theories of change to characterize causal mechanisms that can guide the collection of data and the interpretation of results." (Miteva, Pattanayak, and Ferraro, 2012).

The paper is organized as follows: it first exposes the analytical framework and the database which the literature review relies on (Section 2); it reveals the ToC of PIDDTs, showing causal mechanisms and conditions at stake for a PIDDT to be effective, according to evaluators (Section 3); in this light, it discusses how PIDDTs effectiveness is addressed by the evaluation literature corpus and exposes its blind spots (Section 4).

2 Conceptual framework and methodology

This section presents the typologies and terminologies used in this paper to draw the aggregated Theory of Change that results from the literature review.

2.1 Characterizing anti-deforestation policies

In order to characterize PIDDTs, it was important to build on the existing efforts determining an agreed typology of PIDDTs (e.g. Angelsen, 2010), while adapting it to the central question of PIDDTs' causal mechanisms. The typology described below is based on terms commonly used to characterize PIDDTs in evaluation papers. It differentiates the types of PIDDTs according to the degree directness with which they target deforestation (with different numbers of causal steps).

A categorization of three different types of anthropogenic drivers of deforestation and forest degradation is described in Table 1, following the work of Geist and Lambin (2001; 2002). This categorization differentiates *proximate* and *underlying* causes. *Proximate causes* are defined as "human activities or immediate actions at the micro-local- level, such as agricultural expansion, that originate from intended land use and directly impact forest cover". *Underlying causes* are "the fundamental social processes, such as human population dynamics or agricultural policies that underpin the proximate causes and either operate at the local level or have an impact on the national or global level" (Geist and Lambin, 2002).

Table 1. Typology of anthropogenic drivers of deforestation and forest degradation

	Proximate causes	**Underlying causes**
Micro-level (local scale)	Direct Pressure Ex.: forest conversion from agricultural or city expansion…	Indirect local pressure Ex.: Local dependence on agricultural expansion, poverty…
Macro-level (national or global scale)	∅	Macro-level pressure Ex.: market drivers like the demand for commodities driving forest conversion…

Source: Geist and Lambin, (2001 and 2002)

Deriving from this categorization, a typology of three major types of PIDDTs is proposed in Table 2. Each PIDDT type is defined according to the category of anthropogenic drivers of deforestation it is designed to respond to:

- **Regulatory instruments** target proximate causes ("direct pressure"), labelled as "**command-and-control instruments**", acting at the local scale (Lambin et al., 2014; Wunder, 2007);
- **Economic and educational instruments** target underlying causes by creating a constraint on or an incentive for the economic agents; such instruments can be economic or educational (awareness), and can act on micro- or macro-level drivers:
  - They can target "indirect local pressure" (table 1) by being directly oriented towards the local economic agents (e.g. economic incentives via a Payment for Ecosystem Services; economic constraint via a forest tax policy; or raising awareness and influencing behaviours via local educations programs), in which case they are described as "**Incentive-based instruments oriented toward local actors**" (called "incentive-based instruments hereafter); or
  - They can target "Macro-level pressure" (table 1), by putting pressure or generate incentives towards the economic agents downstream the supply chain such as the consumers (e.g. by reducing consumption of deforestation-driven products via Certification), in which case they are described as "**Supply chain instruments**".

Table 2. Typology of Policy Instruments dedicated to combatting Deforestation and forest Degradation in the Tropics (PIDDTs)

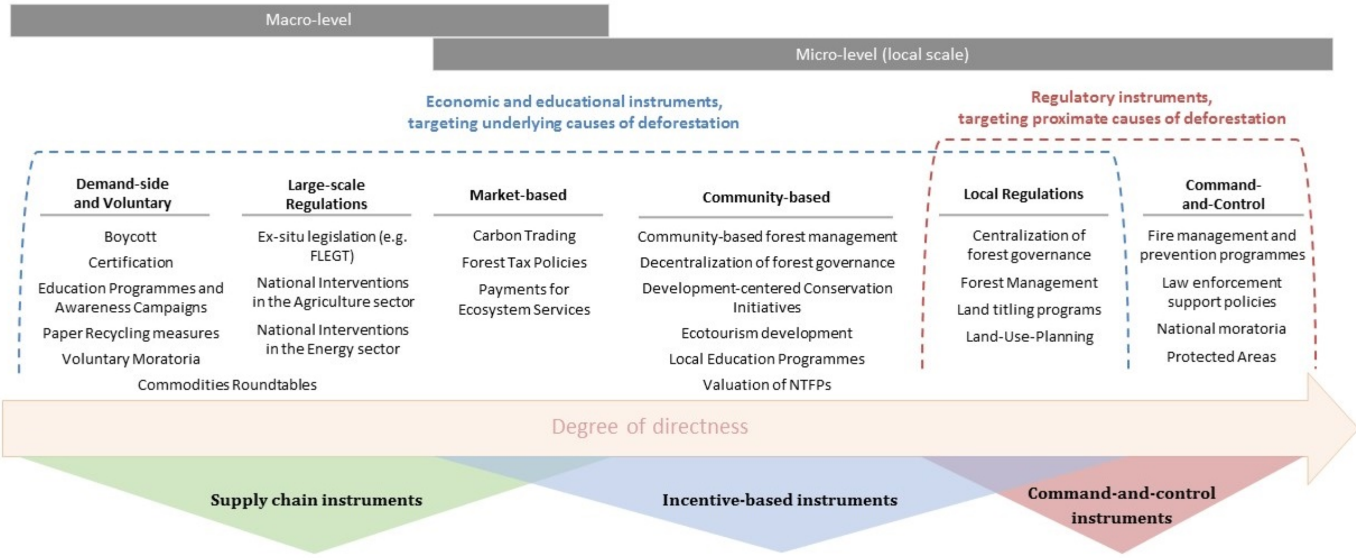
	Regulatory instruments, targeting proximate causes	**Economic and educational instruments, targeting underlying causes**
Micro-level (local scale)	Command-and-control instruments e.g. Protected Areas, Forest codes, National moratoria, etc.	Incentive-based instruments oriented toward local actors e.g. Local PES, CBNRM, local education programs, etc.
Macro-level (national or global scale)	∅	Supply chain instruments e.g. forest Commodities Roundtable, Carbon Trading, soy moratorium, etc.

Source: Authors' elaboration.
PES: Payment for Ecosystem Services; CBNRM: Community-Based Natural Resource Management.

Since PIDDTs target drivers of deforestation that may be more or less direct, they can also be considered as more or less direct instruments. For instance, a protected area rather directly targets deforestation, while paper recycling measures relate to a rather indirect policy instrument. Figure 1 displays the twenty-six (26) different PIDDTs that were identified in the literature, according to the typology used here (Table 2), and ordered by their degree of directness.

This typology is not univocal as certain instruments may correspond to different types, according to the context in which they are established (e.g. market-based instruments can rather be local and directly oriented towards individuals, or implemented at a macro level such as a carbon tax).

Figure 1. Classification of the different PIDDTs found in the literature, by degree of directness



Source: Authors' elaboration.
FLEGT: Forest Law Enforcement Governance and Trade; NTFPs: Non-Timber Forest Products.

2.2 Using a Theory of Change to analyse causal mechanisms and understand the effectiveness of anti-deforestation policies

Various approaches to defining a theory of change exist. Howard White's definition is chosen here (White, 2009) and illustrated in Table 3: it formalises causal mechanisms and linkages (transmission channels), in a logical order, from means and action implemented (Input) to their direct consequences (Outputs), their results (Outcomes, be they intermediary or final), and ultimately their final desired social and biophysical impacts (Final Impacts). The difference between "final outcomes" and "final impacts" lies in that "outcomes" can be reliably attributed to the policy, while "final impacts" are rather considered as beyond the policy "accounting ceiling". In the case of PIDDTs, avoided deforestation is considered a final outcome, while the various social and economic benefits provided by avoided deforestation will rather be considered as final impacts, including biodiversity conservation, carbon emissions mitigation, watershed protection, and poverty alleviation. Nonetheless, trade-offs can occur between the different benefits of forest preservation, as it will be discussed later.

The effectiveness of a PIDDT can be assessed at every node of the causal chain. Meijer (2015), for instance, distinguishes three successive levels of effectiveness when analysing supply chain instruments: the degree of implementation (effectiveness in the *output* production, in the first nodes of the causal chain); the level of behavioural change (effectiveness in the *intermediary outcome*, in the intermediate nodes); and finally the magnitude of reduced deforestation (effectiveness in the *final outcome*, in the final nodes). This framework will be used here to structure the literature review.

Table 3. Different causal steps within the Theory of Change

Inputs	***Outputs***	***Intermediary and final Outcomes***	***Final Impacts***
Policy implementation and concrete action	Direct consequences from action / policy implementation	Intended results of the policy, which are reversible, measurable and attributable to it	Social and bio-physical transformation on a large scale of space and time (not necessarily fully attributable to outcomes).

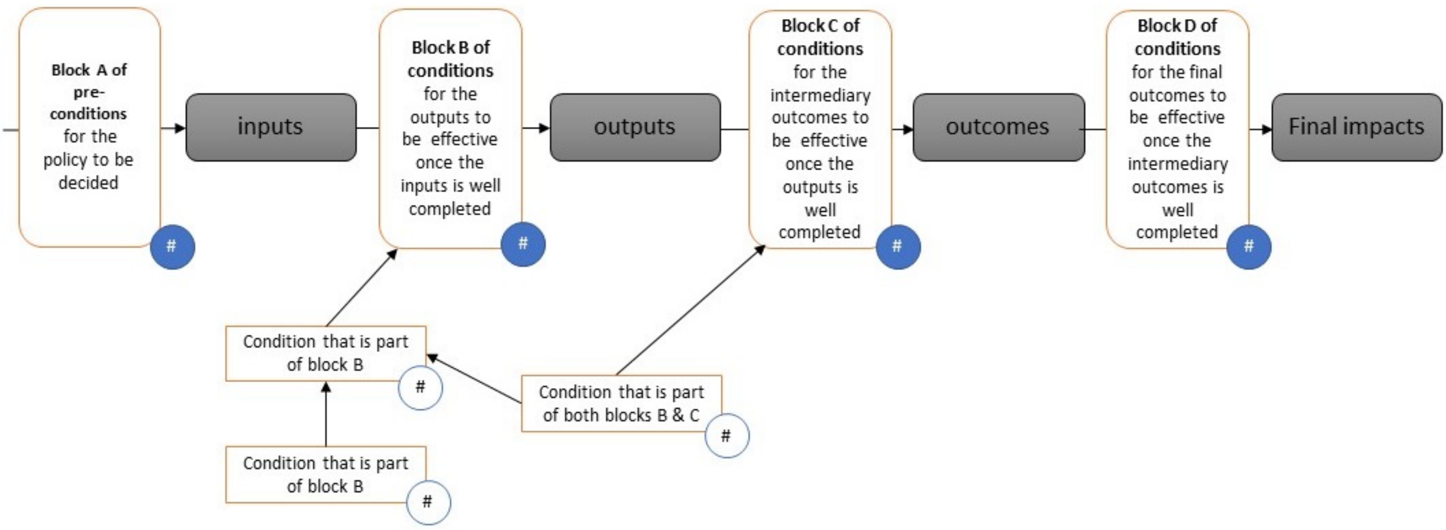
Source: Authors' elaboration, adapted from White, 2009.

2.3 Formalizing the aggregated Theory of Change for anti-deforestation policies

Visually, the results section (section 3) displays causal mechanisms at stake and their effectiveness conditions for each PIDDT type, according to the literature review. The representation of the three resulting PIDDT causal chains follow the mapping model in Figure 2 below.

Three types of information are included in the mapping model. First, pre-conditions to the policy decisions are displayed (Block A). Then each causal node (grey boxes) in the causal chain illustrates each inferred change. A number of conditions to the achievement of the causal node are identified on its left (white "blocks"); for instance, inputs lead to output, only if block B of conditions is realised. Each block of conditions is, therefore, an aggregate made out of individual and specific conditions. The symbol "#" indicates the number of articles found in our sample that deal with the corresponding block or individual conditions.

Figure 2. Visualizing an aggregated Theory of change (for a given PIDDT type)



Source: Authors' elaboration.

2.4 The database[5]

A Boolean search was performed in October 2015, using a keywords selection (Table 4) purposely selected to capture a vast diversity of phrasing related to PIDDTs evaluation.

Keywords were chosen to reflect respective categories of "studied objects", "action", "instruments", and "results" (Table 4)[6]. To allow for a replicable systematic review, the database was limited to peer-reviewed scientific literature. Elseviers' Scopus search engine was used because it stands as the biggest online bibliographic database of scientific papers, particularly in recent years and in social sciences. An iterative checking process was performed to validate this keywords selection, by testing the corresponding database with a set of a dozen well-known articles of the field, and their references.

Table 4. Keywords selection to obtain the data collection[7]

Studied objects	Action	Instruments	Results
deforest* ; forest W/3 degradation	reduc* ; protect* ; preserv* ; conserv* ; fight ; avoid*	program* ; policy ; management ; initiative ; intervention ; instrument ; planning ; project ; strategy	Impact ; evaluat* ; effect* ; consequence ; output ; outcome ; additionality

Search results provided a corpus of 3,609 texts (named hereafter the "extended database"), dating from 1974 up to October 2015. They were sorted out based on their nature and on their relevance. Since they generally do not follow peer-review procedures, book chapters and conference papers were excluded. Relevance was assessed through systematic reading of titles and abstracts, based on the nature of the evaluation (empirical evaluations only), the nature of the policy (only policies dedicated to combatting gross deforestation) and the geography (developing countries in the tropics). Consequently, papers dealing with model-based predictions and/or scenarios-based evaluations, reforestation policies, and PIDDTs in non-tropical countries and developed countries were excluded. The geographical focus on tropical developing countries is due to a need for homogeneity in terms of social contexts and policy issues.

Applying this series of relevance criteria, 264 papers (named after "the selection") were selected. Articles address a single PIDDT, or several PIDDTs in isolation or combined.

Most selected papers date from after 2004. The research coverage appeared unbalanced in terms of geographical criteria. For instance, over twice more articles evaluate PIDDTs located in Latin America (41.3% of papers) than in Africa (19.7%). Articles in the selection also tend to evaluate policies much more often at the local scale (N= 244, 92% of the selection) rather than at the global or national scale. With 159 articles in the selection, assessments of incentive-based instruments are a majority (60 %), while 114 articles evaluate command-and-control instruments (43%). Protected Areas (within "command-and-control instruments") are most researched (N=89, 33%), which reflects the fact they are the most commonly used tool for biodiversity conservation in developing countries. Community-Based Forest Management (N=34, 13%), and

[5] A full description of the database production, the selection methodology as well as a full statistical description and list of articles in the extended database is available upon request.
[6] The choice was made not to include geographical terms into the keywords selection.
[7] In Elseviers' Scopus database we looked for this list within the articles' "keywords", "title" or "abstract".

Payment for Ecosystem Services (N=32, 12%), which are both incentive-based instruments, are similarly well researched. Supply chain instruments are way less evaluated (N=20, 8%).

3 Results

Results consist in (3.1.) mapping the Theory of Change of PIDDT emerging from the selected literature on forest evaluation, and (3.2.) identifying the traits of evaluation research – in terms of policy and instruments coverage.

3.1 The aggregated theory of change of anti-deforestation policies

Building on the analytical framework (Figure 2), cause-consequence links clearly identified in selected papers lay the basis to map an arborescence of causal relations from a PIDDT design (input) to its effectiveness in avoiding and forest degradation deforestation (final output). The synthesis and aggregation of this arborescence form the theory of change of PIDDTs.

First, in section 3.1.1, Figure 3 displays the aggregated ToC emerging from the literature review for each of the three PIDDTs types (Table 2). It shows "blocks of conditions" along the three causal chains, as described in the methodology (Figure 2). Those conditions synthetize all the elements of context (sub-conditions) evoked in the selected literature as influencing the policy effectiveness at its different steps: effectiveness in designing a PIDDT; in implementing it; in generating the expected outcomes. Then, in section 3.1.2, Figures 4 present the series of sub-conditions that compose those blocks. Each condition has been identified in a number of references from the selection, which is indicated in the figures[8] .

3.1.1 Anti-deforestation policies' causal mechanisms

Figure 3 illustrates the causal steps necessary for each of the three PIDDT types to be effective. Three steps are differentiated: the policy decision (input), the implementation (output(s)), and the results evaluation (outcomes).

As intuited, the complexity of causal chains increases when policies are less direct and less local and conversely. Only 4 causal steps are described for Command-and-control instruments to avoid deforestation effectively, mostly through its necessary legal definition, law enforcement, and relevant location. The causal chain of incentive-based instruments is more complex as it may also aim to generate socio-economic outcomes (two intermediary outcomes, environmental and social), and that the incentive generated by the policy (input) might lead to both a change in behaviour and in awareness from local economic agents, which can mutually nurture each other (two outputs). Last, supply chain instruments require more causal steps, as they are originating at the macro-scale. It means that their first intermediary outcome is to generate an incentive at the local scale, via a demand signal on the market of deforestation-driven products; once the incentive is generated in the field, the policy effectiveness depends on a similar causal pattern as the incentive-based instruments'. All causal chains however converge at the final outcome level, since they share a similar objective, i.e. avoiding or curbing deforestation.

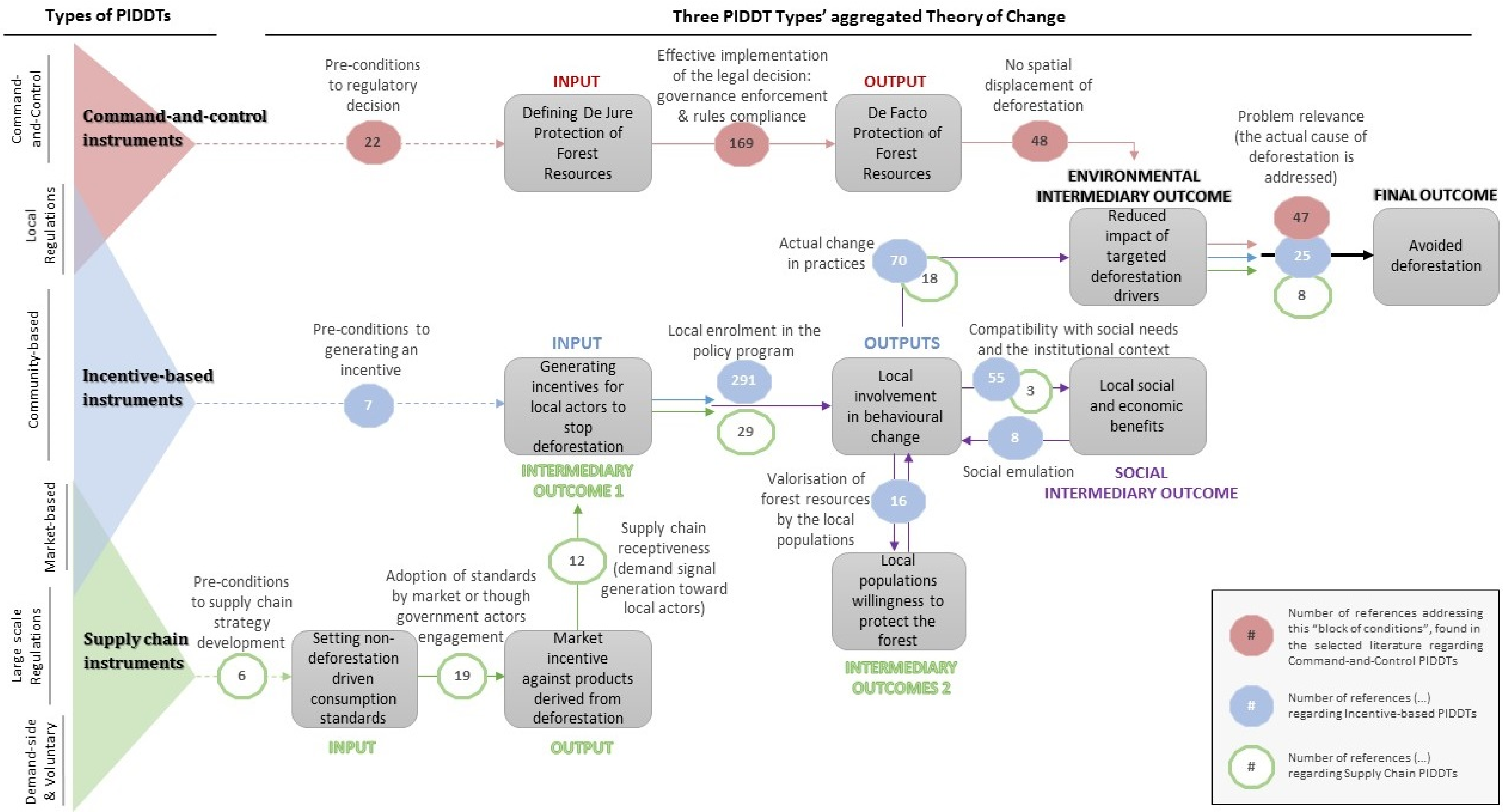
[8] For each sub-condition displayed in the figures, the list of references, with corresponding quotations, is available upon request.

However, the necessity for more causal steps to reach the final outcome does not necessarily mean that the PIDDT will be less effective in avoiding deforestation, as PIDDTs respond to different conditions, which will be better highlighted in the following Figures 4.

Most identified conditions are located at the local implementation phase of the policy instruments (from input to output for local scale PIDDTs, and from the first to the second intermediary outcome for macro-scale PIDDTs). For example, regarding command-and-control instruments, 22 references are reported from the selected literature on the pre-conditions for the regulatory decision to be taken (input level); 169 on the effective *de facto* protection of forest resources (output), 48 on the effective impact reduction of the targeted drivers (intermediary outcome), and 47 on the effectively avoided deforestation (final outcome).

However, some studies also show that a successfully implemented policy does not necessarily avoid deforestation if the actual deforestation driver is not properly addressed ("Problem relevance" in Figure 3). This could indeed result in deforestation being displaced, or simply unchanged, if the localization, the population, or the market targeted by the PIDDT are not those that actually contribute to deforestation.

Figure 3. Spotlight on PIDDTs' causal mechanisms: Overview of the Theory of Change (ToC) of Policy Instruments dedicated to combatting Deforestation and forest Degradation in the Tropics (PIDDTs), aggregated from the literature review.



Note: The "types of PIDDTs" on the left side follows Figure 1. Classification of the different PIDDTs found in the literature". Grey text boxes indicate the different causal steps, and the white text boxes indicate the "blocks of conditions" following the analytical framework of Figure 2. Visualizing an aggregated Theory of change (for a given PIDDT type)". The steps of the ToC (from the input to the final outcome) is indicated in red for Command-and-control instruments, in blue for Incentive-based instruments, in green for Supply chain instruments, in purple for the convergence of Incentive-based and Supply chain instruments, and in black for the convergence between all three types of instruments. Please refer to paragraph 2.3 for further explanation on how to read this figure. To facilitate the reading, "avoided deforestation and forest degradation" is simplified as "avoided deforestation".

3.1.2 Detailed map: the effectiveness conditions of anti-deforestation policies

Figures 4.1, 4.2 and 4.3 map the precise conditions at stake at every causal step, of respectively Command-and-Control PIDDTs, Incentive-based PIDDTs, and Supply Chain PIDDTs.

Conditions that are common to more than one type of PIDDT are highlighted (yellow stripes), drawing attention on the common denominators between the three causal chains, as well as their specific features. For instance, Figures 4.1 shows a total of 17 different sub-conditions at the output levels for the Command-and-control PIDDTs. Thirteen (13) of them are common to the output conditions for Incentive-based PIDDTs (Figure 4.2).This suggests that similar contextual factors influence the implementation of the policies on the ground, regardless of the policy. However, the three different PIDDT types do not share the same conditions for effectiveness at the intermediary outcome level. This is however the level where the causal chains converge, sharing the same last causal steps. For instance, the environmental intermediary outcome "reduced impact of targeted deforestation driver(s)" is common to all three causal chains, however conditions to reach it widely differ across the different PIDDT types: only 4 out of the 14 conditions are common to at least 2 causal chains (as highlighted in Figures 4.).

A few conditions are found at different nodes of the causal chains. For instance, for command-and-control instruments, "Minimal Political Willingness" is a condition to the legal decision (input level), but it also conditions the effective implementation (output level) and the relevance of the policy (final outcome level). Regarding incentive-based instruments, a "Supportive and Uncorrupt Local Governance with Evolved Institutional Arrangements" (Dietz, Ostrom, and Stern, 2003), is both a condition for "behavioural change" (output level), "Local social and economic benefits" (social intermediary outcome), and for a "Reduced Impact of the Targeted Driver" (environmental intermediary outcome).

Last, some controversies are exposed regarding whether a certain element leads to more or less effectiveness of the policy. For example, opinions may differ on whether the stringent restriction of access to forest resources results in more successful Command-and-Control policies or not (Figure 4.1).

Figures 4. Detailed Theory of Change of PIDDTs. Spotlight on the effectiveness conditions of anti-deforestation policies

Figure 4.0. Legend of figures 4.1, 4.2, 4.3, detailing the Theory of Change of PIDDTs

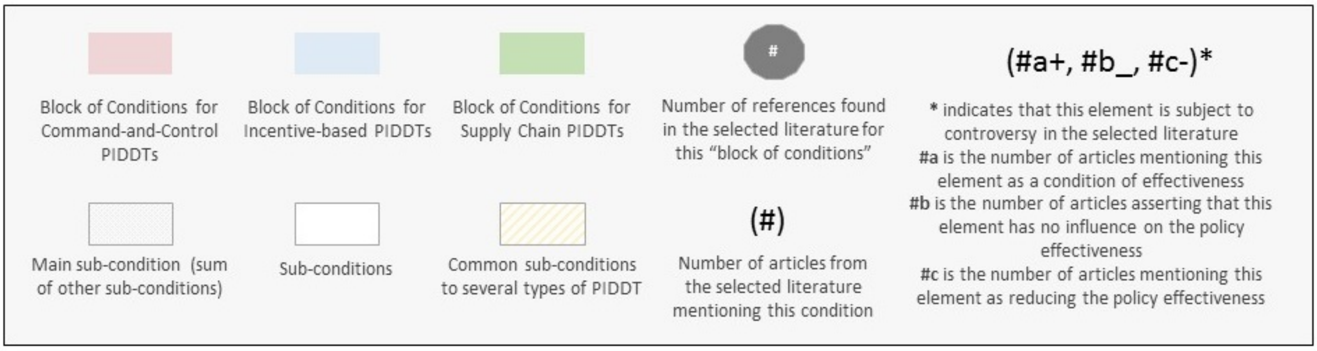


Figure 4.1. Detailed ToC of Command-and-Control PIDDTs

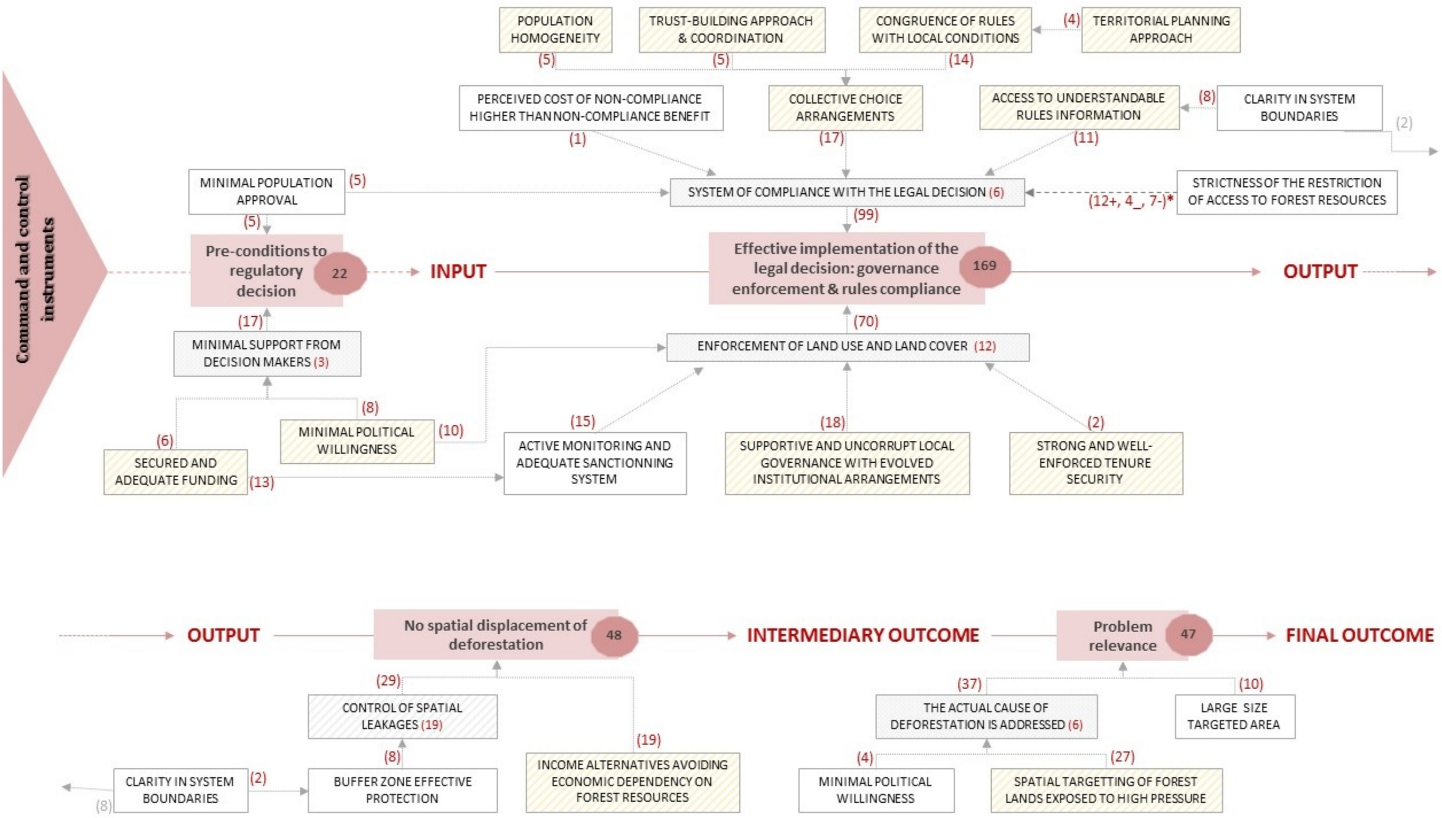


Figure 4.2. Detailed ToC of Incentive-based PIDDTs

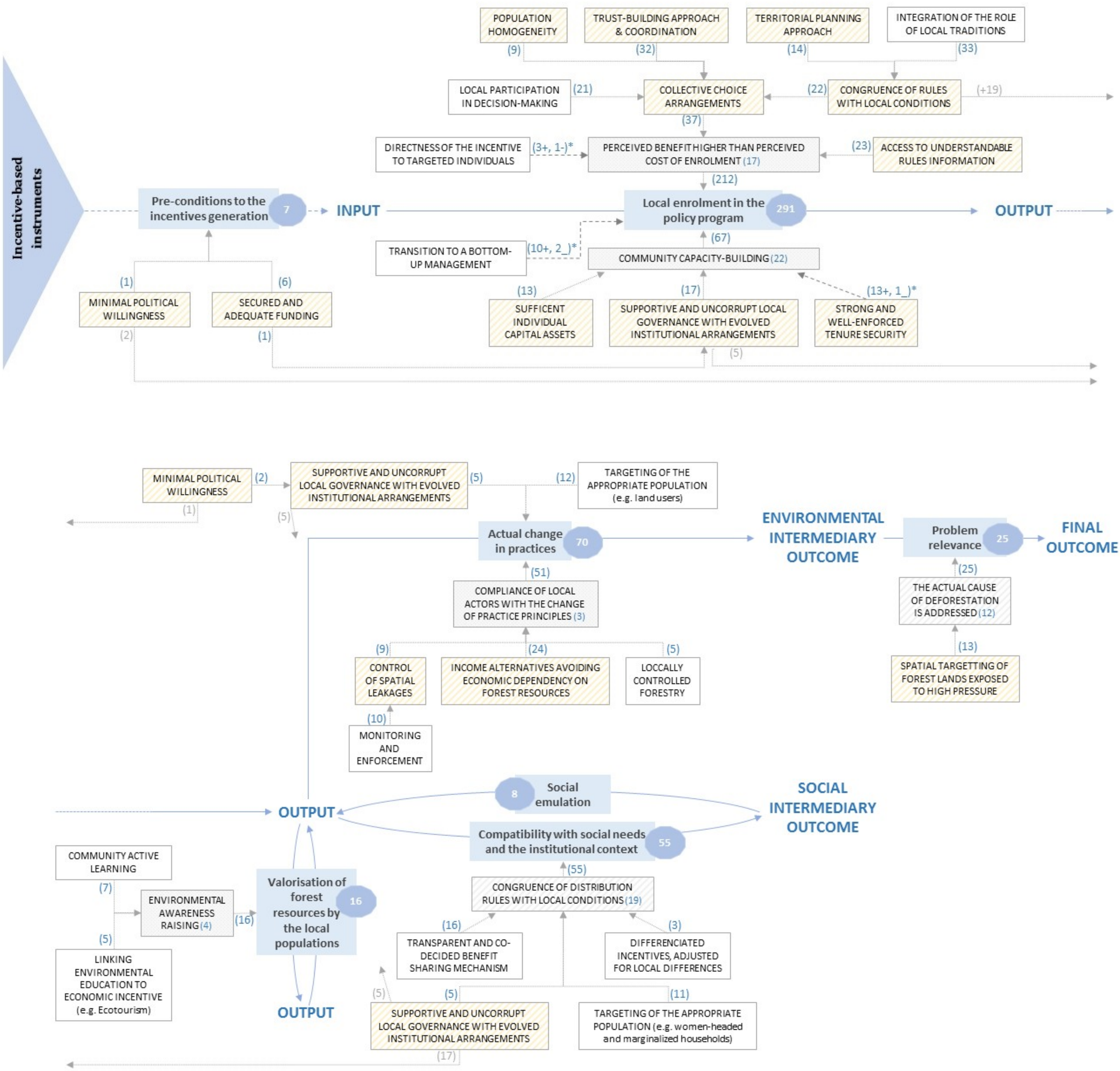
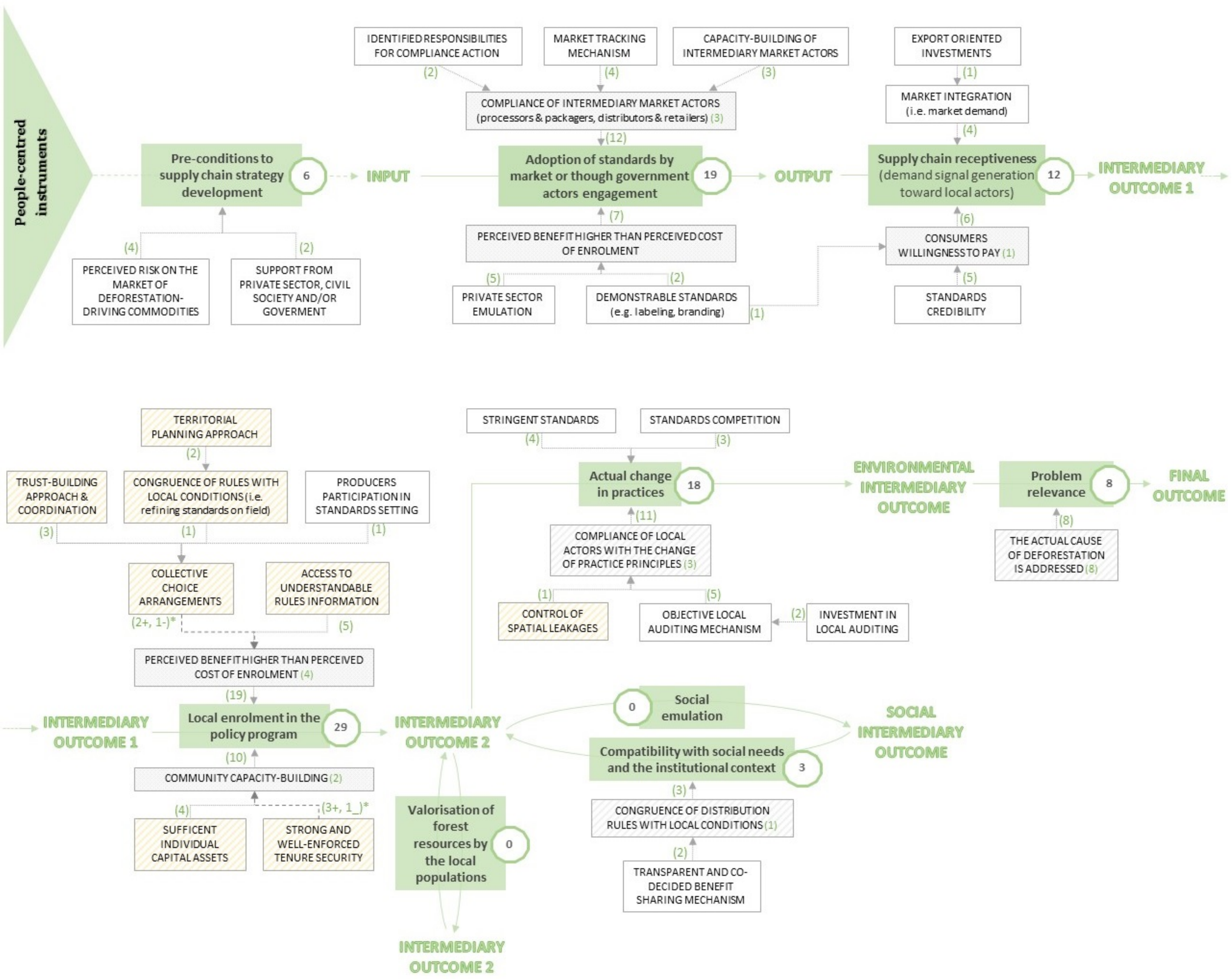


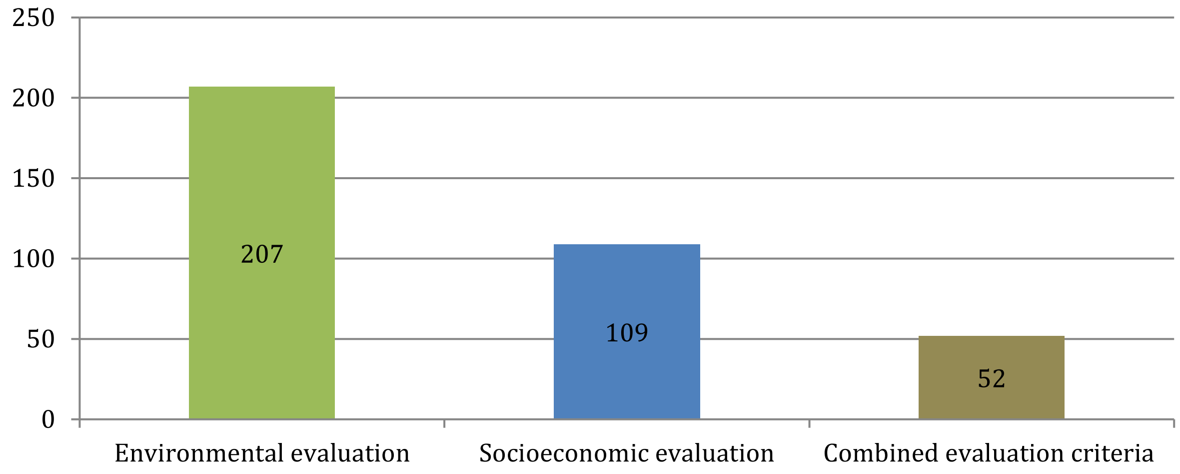
Figure 4.3. Detailed ToC of Supply Chain PIDDTs



3.2 What does the evaluative research on PIDDTs focus on?

PIDDTs are expected to have environmental outcomes, evaluated based on forest cover change and biodiversity indices among other evaluation criteria. They may also aim at socioeconomic outcomes, which evaluators look at through changes in the livelihood, or in the employment rate. Figure 5 shows - based on the selected articles - the extent to which forest evaluators look at PIDDTs' effectiveness through environmental criteria and/or socioeconomic ones.

Figure 5. Number articles evaluating anti-deforestation policies according to environmental and/or socioeconomic criteria



Note: This graph indicates the number of texts from the data collection (264 forest policy evaluation papers) using environmental and/or socioeconomic criteria. Most publications focus on a sole type of evaluation (80%), while some others combine both types of evaluation criteria (20%).

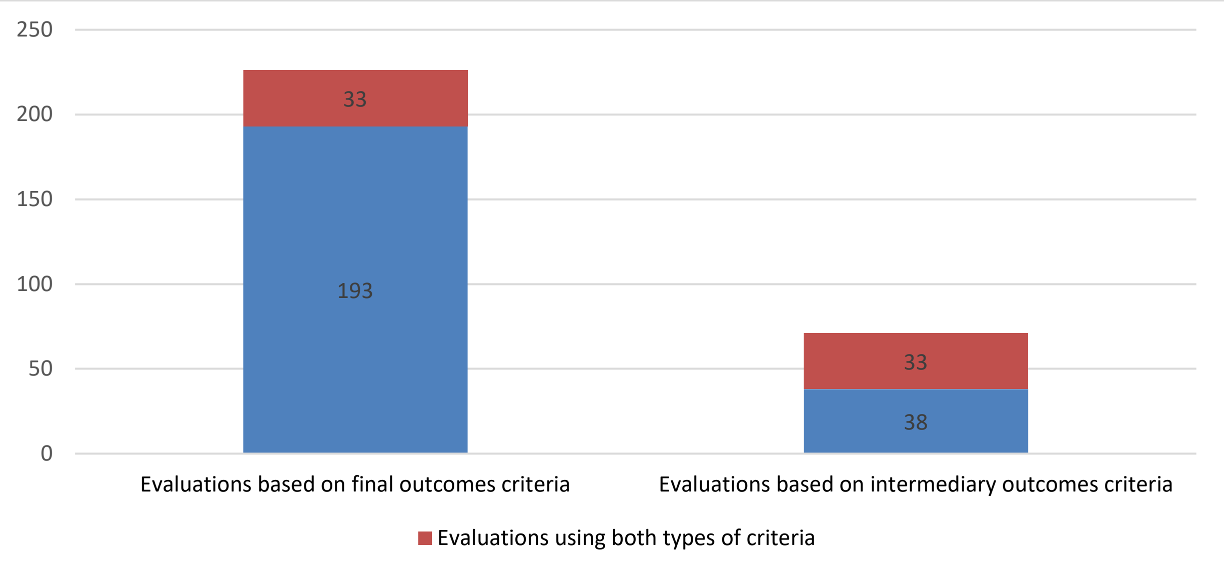
The majority of selected articles (N=207, 78% of the selection) undertakes PIDDT evaluation in light of environmental criteria (see Figure 5). Significantly, out of these, 109 articles (38%) use avoided deforestation proxies (*e.g.* change in forest cover, land use or logging level) in order to assess the PIDDT success - or lack thereof. Such environmental outcomes are indeed more easily subject to quantitative evaluations, especially since the standardisation and spread of remote sensing, geographical information system (GIS) techniques and Spatial Multi-Criteria Analysis (SMCA). Those techniques have allowed collecting large samples of aerial and spatial data on forest cover, for relatively low costs and short time (Ferretti-Gallon, and Busch, 2014). Other environmental criteria include biodiversity conservation measures, carbon sequestration calculations, illegal fires incidences, etc.

Still, quite a large part of articles (N=109, 41%) use socio-economic evaluation criteria. Most of them correspond to indicators of improvement in local livelihood, social welfare, or equity. Others include changes in behaviours, social empowerment, as well as general economics such as the effects on price or employment. Least evaluated socio-economic criteria include changes in institution and governance, in demography, in production performance, etc.

Some articles (N=52, 20%) combine both categories of criteria, for example using remote-sensing data on forest cover together with on-site interviews to estimate the change in landowner behaviour (*e.g.* Scullion *et al.*, 2011; Bruggeman, Meyfroidt, and Lambin, 2015).

Last, few articles include in their evaluation the PIDDT's capacity to sustain its effect on the long run. Overall, only 11 selected papers (4%) assessed for policy permanence.

Figure 6. Number articles (in the selection) evaluating anti-deforestation policies according to their final and/or intermediary outcomes



Note: This graph indicates the number of texts from the selection evaluating final outcomes (avoided deforestation, avoided forest degradation, socioeconomic benefits generation), or intermediary outcomes (change in behaviour, change in the level of threat to which an area is exposed, level of enrolment in the programme, etc.), or both levels of outcomes.

A large majority of the selection (N=226 texts, 86%) evaluate PIDDTs in light of their final outcomes (Figure 6). Such evaluation criteria include proxies of avoided deforestation (tree cover, land use cover, etc.), environmental benefits from avoided deforestation (biodiversity conservation, watershed protection, etc.) and socioeconomic benefits from the policy (local livelihood, social welfare, poverty level, etc.). In comparison, 71 texts (27%) provide evaluations of intermediary outcomes, through criteria including a reduction in the targeted drivers (logging intensity, fire incidence, etc.), as well as policy effective implementation (compliance of actors, enrolment in the policy programme, enhancement of perceived forest value, etc.). Finally, 33 texts (13%) evaluate both levels of outcomes.

4 Discussion

Analysing the available scientific literature on the effectiveness of PIDDTs, through the lens of their theory of change, allows uncovering "why" and "how" forest policies effect (or fail to), according to their evaluators.

The distribution of the conditions along the causal chains will be first discussed in order to shed light on how contextual parameters influence the effectiveness of a PIDDT (4.1), we will then question the ability of PIDDTs to integrate both environmental and socio-economic goals (4.2). Finally, we will discuss how this literature review exposes what is most researched by evaluators while revealing some blind spots (4.3).

4.1 How does the effectiveness of anti-deforestation policies vary with context?

That most identified conditions concern the implementation phase of the policy instruments locally indicates that, according to evaluators, the success or failure of anti-deforestation policies mostly lies in its effective implementation. It concerns the ability of the PIDDT design to achieve either compliance of local actors to the policy rules for command-and-control instruments; or social acceptance of the incentive or pressure, generated by the instrument directly for incentive-based instruments, or by the market signal for supply chain instruments.

With respect to command-and-control instruments, a successful implementation appears to lie in the enforcement, which in turn depends on an extensive communication regarding the objective and the rules of the policy[9], especially regarding its spatial scope (delimitation of the area to which the instrument applies)[10]. For example, encroachment in protected forests is often seen as resulting from uncertain forest boundaries, aligning with one of Ostrom's eight principles (clearly defined boundaries for Common Pool Resources; Ostrom, 1990). Uncertainty over the policy outcomes and over its promised social or economic benefits also appears to hinder policy compliance, as it was seen for instance in strip plantations in Bangladesh (Muhammed *et al*., 2011).

Our results then suggest that evaluators, taken as a whole, consider that the effectiveness of PIDDTs mostly depends on the policy scheme itself. More specifically, it would depend on the policy scheme's ability to build on "secured and adequate funding", to give a clear "access to understandable rules", and to include the population in the policy implementation ("collective choice arrangements") among other conditions which mostly condition the implementation of the instruments (Figures 4.1, 4.2, 4.3).

However, local context-specific factors count for the majority of conditions reported, from politico-institutional factors to economic and cultural ones. The willingness and ability of the local governance to support the policy project appear as determinant[11]. Economically, the policy scheme needs to account for any economic dependency from local population to the exploitation of forest resources[12]. Culturally, the integration into the policy of exiting cultural assets such as

[9] "Access to understandable rules information", Figure 4.1.
[10] "Clarity in system boundaries", Figure 4.1.
[11] "Supportive and uncorrupted local governance with evolved institutional arrangements", Figures 4.1 and 4.2.
[12] "Income alternatives avoiding economic dependency on forest resources", Figures 4.1 and 4.2.

local forest-related traditions[13] seems also essential to ensure the population enrolment in and/or compliance with the policy instrument.

Such local conditions are driven by larger-scale external influences (Sassen et al., 2013; Rajão, Azevedo and Stabile, 2012). Those include the political interest[14], the demographic structure[15], the broader economic situation[16], and the market access[17], among other macro influences. For instance, Engel and Palmer's analysis (2011) demonstrates how globalization weakens decentralisation initiatives transferring forest management to the benefit of local communities, and may even lead to enhanced deforestation. Evaluations suggest the importance of ensuring the alignment of a PIDDT with different sectoral policies within national governments (Rajão, Azevedo and Stabile, 2012).

Several examples show that failure of the policy planning to integrate both local and macro contextual factors could result in the PIDDT being unable to avoid deforestation, or even to generate inconsistencies and have detrimental effects on deforestation. For example, the type of governance systems implemented may also clash with the requirements of community-based forest policy instruments (Leventon *et al.*, 2014). In addition, central governments tend to oppose the decentralization of resource management (Ribot, Agrawal and Larson, 2006). In Mexico, the reinforcement of *ejidos* governance aimed to reduce deforestation, but evaluation showed that it increased deforestation by encouraging the expansion of agriculture (Ferretti-Gallon and Busch, 2014).

While evaluators tend to show that PIDDTs effectiveness depends on its implementation phase rather than on its policy design, they tend to focus their evaluations on outcomes rather than on the design phase. This concurs with warnings from Wilshusen and colleagues (2002) about the risk of "ignor[ing] key aspects of social and political processes that shape how conservation interventions happen in specific contexts".

Nevertheless, even when correctly implemented, a PIDDT might not reduce deforestation if it is ill conceived, and especially if it does not address the main drivers of deforestation. For example, PIDDTs are more efficient when targeting locations subject to higher deforestation pressure[18]. Threats indeed greatly vary in space (Ferraro and Hanauer, 2011) and time (Haruna et al., 2014), and political pressures are suspected to direct the PIDDTs to locations and moments where pressure — and opposition — are minimized, therefore reducing policy effectiveness (Pfaff, and Robalino, 2012).

Policy planning resting on a cautiously designed theory of change will therefore pay attention to the contextual macro conditions (Miteva et al., 2012; Joppa and Pfaff, 2011; Singh *et al*., 2011), so as to adequately design the policy targets as well as, *in itinere*, to adapt the policy's means of action to contextual changes. It will also better highlight eventually contradictory causal mechanisms to reach different policy targets and take trade-offs into account when setting priorities (Dyer *et al.*, 2012).

[13] "Integration of the role of local traditions", Figure 4.2
[14] "Sufficient political willingness", Figures 4.1 and 4.2
[15] "Population homogeneity", Figures 4.1 and 4.2
[16] "Sufficient individual capital assets", Figure 4.2 and 4.3
[17] "Supply chain receptiveness (demand signal generation toward local actors)", Figure 4.3
[18] "Spatial targeting of forest lands exposed to high deforestation pressure" Figures 4.1 and 4.2

4.2 Can anti-deforestation policies realistically generate both environmental and socioeconomic benefits?

The aggregated ToC map (Figure 3) shows that anti-deforestation policies often result in a combination of environmental, social and economic changes. However, as stated by Chapman and colleagues (2016): ''improving ecosystem outcomes, economic and material benefits, forest cover and carbon sequestration are commonly stated objectives, but they are not necessarily convergent".

PIDDTs causal chains can indeed integrate both environmental outcomes (avoided deforestation and forest degradation) and socio-economic outcomes. Conditions to reach those different outcomes can sometimes be antagonistic or synergistic. For instance, the condition "Targeting the appropriate population", regarding incentive-based PIDDTs, appears on both outcomes branches, meaning it influences both environmental and socio-economic benefits achievements (Pfaff et al. 2007; Romero, 2012; Robalino and Pfaff, 2013; Mahanty et al., 2013; Jewitt, et al., 2014; Chapman et al., 2016; Brimont et al., 2015). However, the "appropriate population" to be targeted to avoid deforestation may differ from the "appropriate population" for generating socio-economic benefits. More socio-economic benefits will indeed be generated if the policy targets poor populations while more environmental benefits will be delivered if the policy targets populations with higher deforestation risk who are not necessarily the poorest (e.g. larger landholders, owners of potential fertile agricultural areas, etc.),.

Furthermore, trade-offs can be needed within the same policy goal. Regarding socio-economic benefits, for example, Larson, Barry and Dahal (2010) mention trade-offs between orienting profits generated by new tenure rights toward businesses and their members, or toward community projects, with different implications for employment and wage income. Regarding environmental benefits, conditions to maximize carbon storage often differ from conditions to enhance biodiversity conservation or watershed preservation, notably in terms of spatial prioritization (Busch and Grantham, 2013).

This stresses the difficulties involved in designing policies that generate all kinds of benefits without prioritizing one. Those policies critically hinge upon the Tinbergen rule according to which every policy target should be supported by at least one policy tool (Knudson, 2009). This is exemplified by the controversy on integrating both forest conservation and poverty alleviation into the same policy scenario which is hoped to be a win-win solution.

This debate was crystalized around Wunder's (2011) and Muradian et al.'s (2013) papers, both warning on the "unrealistic expectations on the (…) prospect of sustainable forest development" (Wunder, 2011) and that "win-win solutions at the interface of conservation and development are (only) possible under particular institutional and governance contexts" (Muradian et al., 2013). Some of the conditions reported in our results confirm that environmental and socio-economic benefits can be produced together under particular contextual conditions only. Such conditions are for instance targeting lands subject to strong pressure while not hindering economic activities, selecting population targets accordingly, and cautiously organizing the distribution of benefits while avoiding social conflicts.

4.3. Blind spots and avenues for research

Results show that PIDDTs' effectiveness relies on a complex balance of local and macro contextual factors. However, the degree of influence of reported conditions on the policy effectiveness is poorly evaluated, both qualitatively and quantitatively. For example, the existence of "collective choice arrangements" is identified as an important condition for an effective policy implementation, however little is known on *how much* it affects the success of PIDDTs.

The fact that most effectiveness conditions are searched for at the implementation phase tends to revive the question of its evaluation; it shows a need for more empirical evaluations rather than (spatial) modelling only, thus concurring with observations by Vincent (2015) and Ferraro and colleagues (2015). Strictly physical terms (e.g., forest cover change) used in most impact evaluations ignore heterogeneity in the costs and benefits, especially for local populations.

Moreover, our mapping of the aggregated theory of change of anti-deforestation policies, and of its coverage by research, suggests at least three broad categories of under-researched causal relations:

- Many incentive-based instruments are believed to change people's behaviour through increased knowledge and perceived value of protecting forest resources. It is the case for ecotourism (Almeyda, *et al.*, 2010), or for local training (Bacha and Rodriguez, 2007). However, how such knowledge and modified perceptions actually lead to a change of behaviour appears under-researched.

- Results suggest that the generation of socio-economic benefits can further spread changes in local behaviours, through 'contagion', 'common exposure' (actors respond to similar interventions in a similar manner), or 'selection' (an intervention affects a cluster of connected actors)" (Newton, Agrawal and Wollenberg, 2013). However, the effectiveness of such mechanisms is rarely evaluated.

- The coverage of the different PIDDTs' *final impacts* is yet incomplete, especially with respect to biodiversity conservation, carbon sequestration, and watershed protection.

Our review also confirms the spatial unevenness of the evaluation effort, within tropical regions: evaluation coverage is much less intense in Africa than in Latin America, which may obviously be related to strong inequalities in terms of statistical as well as geographical data availability (Godar et al., 2014; McDermott; Irland, and Pacheco, 2015; Ferretti-Gallon, and Busch, 2014). It also points to a paucity of long-term evaluations and, therefore, lack of quantitative and qualitative pieces of information over the long run.

Although some inconsistency in policy evaluation methods remains (Agrawal, *et al.,* 2014), we also observed a steady increase of PIDDTs evaluations over time, and this gives hope for more data accessibility, which constitutes a *sine qua non* condition to relevantly measure forest policies performance. Better knowledge does not guarantee a better policy. However, it does increase the possibilities for appropriate policy choices (Ostrom, 2009).

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