WORKING PAPER

Qualitative Comparative Analysis (QCA)

An application to compare national REDD+ policy processes

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Working Paper 121

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Edge between oil palm plantation and forest, Papua, Indonesia.

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1 Introduction

In 1987, the American social scientist Charles Ragin built the foundation for Qualitative Comparative Analysis (QCA) with his seminal book *The Comparative Method*. QCA is designed for the comparison of a small to intermediate number of cases. It enables systematic cross-case comparison without neglecting case complexity, allowing modest, medium-range generalization and theorizing. The aim of this working paper is to introduce QCA as a method to study policy processes. In particular, we discuss its application to the Global Comparative Study on REDD+ (GCS-REDD).[1]

The objective of GCS-REDD is to provide policy makers and practitioners with relevant knowledge to ensure effective, cost-efficient and equitable reduction of carbon emissions from deforestation and forest degradation as well as co-benefits (3E+ criteria). Its analyses occur simultaneously with efforts to start and implement REDD+ and try to identify 'what works and what does not.' The paper was developed for Module 1 of GCS-REDD(see Brockhaus and Di Gregorio 2012). This Module analyses the national processes that formulate and implement REDD+ policies and assesses whether the resulting outcomes are meeting the 3E+ criteria, in nine countries with additional studies in three other countries. Each full country study consists of five work modules: a country profile of the institutional context, a media analysis, a policy network analysis, a REDD+ policy content analysis, and a fifth flexible module that can be adapted to specific country research needs.

This working paper gives a general idea of the logic of QCA and its methods and discusses benefits and limitations. It is not aimed at an in-depth methodological guide but rather as an introduction of the approach to readers not very familiar with methods of comparative politics. The references provide useful literature for further reading. It starts with a general overview of QCA, followed by a description of different variations on the original basic method. Next, it applies QCA to GCS-REDD. Limitations and benefits of the method are discussed, and conclusions are presented about its usefulness in guiding REDD+ policy design and implementation.

1 REDD+ means reducing emissions from deforestation and forest degradation, and enhancing forest carbon stocks in developing countries.

2 QCA: An overview

During the last decades, QCA has gained popularity among social scientists interested in alternative ways to analyze and compare a small or medium number of cases. It has thus far primarily been applied to political science and sociology.[2] QCA is a research strategy as much as a set of concrete techniques (Rihoux 2007, 365). It challenges several typical approaches of statistical methods, but also goes beyond the classical case-centered focus of traditional qualitative research. Thus, although called *Qualitative* Comparative Analysis, QCA is not a qualitative method in the sense of empirical qualitative research. Rather, it should be seen as a middle way that combines certain features of the qualitative approach (case orientation, interest in complexity) with those of quantitative research (interest in generalization). Ragin's aim was to use the strengths of case studies but overcome their limitations, to keep the identity of the case but allow for generalizations (Blatter et al. 2007, 190; Lauth et al. 2008, 118). He therefore did not see QCA as a compromise between qualitative and quantitative approaches but rather as a "real alternative to conventional practices" that "transcends many of their respective limitations" (Ragin 2008, 6). Ragin used the term 'qualitative' in order to distinguish his approach from that of statistical logic. However, he never proposed restricting the analysis to qualitative research. For example, quantitative and macro-level data are widely used in QCA studies. In this respect, QCA is sometimes referred to as a macro-qualitative approach.In French, the term *analyse quali-quantitative comparée* is used (Blatter et al. 2007, 204).

Numerous researchers have also combined QCA with other qualitative or statistical analytical tools (see for an overview Rihoux 2007, 377-379), either to confront the different results or to combine them to gain a better understanding. For the analysis of policy networks and processes, Stevenson and Greenberg (2000) as well as Fischer (2011) combined social network analysis and QCA and could show the mutual benefit of these approaches.

Typical qualitative features of QCA are the case orientation, the holistic view of cases as a

2 For an overview, see Yamasaki and Rihoux (2009). Examples of QCA applied to deforestation include Scouvart et al. (2007), Rudel and Roper (1996) and Rudel (2005). A list of publications using QCA can be found at http://www.compasss.org/wpseries/allWPdate.htm and www.restore.ac.uk/qualquanres/papers/Reading_two.shtml.

combination of features and the need for detailed knowledge of cases. Its interest does not lie in the disaggregation of cases into analytically separate variables and the identification of a single cause, but in understanding and conceptualizing the relation between the different causes and how they combine in a given context. It requires the researcher to interpret the combinations and to define and redefine thresholds, which requires in-depth case knowledge and an iterative process (Blatter et al. 2007, 204; Rihoux 2007, 368; Fiss 2010). In this respect, it is a qualitative approach.

The central principles and terms of QCA can be summarized as follows.

- QCA is designed for small to intermediate numbers of cases (around 5 to 50 or even 100) that are too small for statistical analysis but too big for qualitative case research, or the classical comparison of two to five cases with a most similar or most different case design (see Przeworski and Teune 1968; Lijphart 1971). Although a QCA with fewer than 10 cases is difficult, some studies have used QCA for as few as five cases. Quite a few studies with large N (more than 100 or even more than 1000) have applied QCA (for examples, see Rihoux 2007, 379).
- The aim of QCA is enabling systematic cross-case comparison. At the same time, it is a case-sensitive approach.That means it takes the internal complexity of cases into account by allowing complex causations and counterfactual analysis. With this balancing of reduction and complexity, QCA allows modest, medium-range generalization and theorizing.
- In QCA, each case is understood as a specific combination of factors, which are called 'conditions.' Therefore, Ragin speaks not of 'cases' but of 'configurations' (Ragin 2000, 64ff). A configuration is "a specific combination of factors (or stimuli, causal variables, ingredients, determinants, etc. – we call these conditions …) that produces a given outcome of interest" (Rihoux and Ragin 2009, xix).

The main premise of QCA is that of multiple conjunctural causation, which means that (1) most often not one factor but a combination of factors will lead to the outcome; (2) different combinations of factors can produce the same outcome; and (3) one condition can have different impacts on the outcome, depending on its combination with other factors and the context (Rihoux 2007, 367).

These three principles are described in more detail below.

Conjunctural causation

The term 'conjunctural' refers to the assumption that it is usually a combination of factors (in QCA language called 'configuration') rather than a single factor that leads to an outcome. In this configuration, not only the presence but also the absence of a certain factor is assessed as influential for the outcome and therefore measured.This allows a better grasp of case- and context-specific constellations.While in statistical methods such as regression analysis (with the exception of multiple regressions), different variables are treated as competitive and the one with the highest significance is presented as the most probable determining factor, QCA logic assumes that different conditions are complementary and often interdependent. Even if the impact of one factor is small, this factor might be necessary to trigger another factor, thereby contributing to the overall outcome (Blatter et al. 2007, 203). As a consequence, the identified causal relation is usually not one factor but a combination of given and absent factors. These are assessed qualitatively as necessary parts of the causal relation and not quantitatively on the extent of their contribution to the overall outcome.

Multiple causation

Not only can several factors in a specific configuration lead to an outcome – different configurations can lead to the same outcome. This principle of 'equifinality' is probably best described with the old saying that "many ways lead to Rome" (Blatter et al. 2007, 201). In this way, QCA allows the identification of alternative ways to reach an outcome depending on the context.

It is even possible that a certain factor has different causal effects depending on the specific configuration. Thus, depending on the combination with other factors, its presence can have a positive or negative effect on the outcome, or its presence and its absence may at different times be a necessary part of the configuration. With other methods, this would have led to the conclusion that the factor was irrelevant.

Thus, multiple conjunctural causation implies that there is no permanent and uniform causality, but that causality is always specific to context and configuration (Berg-Schlosser et al. 2009, 8ff). How the combination of factors works has to be explained by the researcher based on case knowledge.

Necessary and sufficient conditions

A central element of QCA is that, in identifying different combinations of factors, it allows differentiation between necessary and sufficient conditions or configurations. The presence of a sufficient condition (A) always leads to the outcome (X). Thus, whenever we observe condition A, we observe outcome X – condition A is a subset of outcome X (Figure 1). But according to the logic of multiple causation, outcome X could also be the result of another condition or configuration, without the presence of condition A.

A necessary condition (B), in contrast, has to occur for outcome X to occur; the outcome cannot happen without the condition. The absence of condition B would lead in every case to the absence of outcome X. However, this does not imply that when there is B, there is always X, as according to the logic of conjunctural combination, B might have to be accompanied by another condition to be effective. Thus, outcome X is a subset of condition B (Figure 2). In other words, A always leads to X, but there can be X without A; B usually leads to X, but there can be B without X. Only if a condition is both necessary and sufficient will it always be observed in every case of the result and vice versa (Blatter et al. 2007, 199).

Certain conditions might be neither sufficient nor necessary but might nevertheless play a role in the outcome as part of a configuration. Such conditions can also be revealed with QCA. They are called INUS-conditions and SUIN-conditions. An INUS-condition is an"insufficient but necessary part of a configuration which is itself unnecessary but sufficient for the result." Thus, condition A may by itself be neither sufficient nor necessary but may, as part of a combination, have a causal effect. A SUIN-condition is a sufficient but unnecessary part of a configuration that is insufficient but necessary for the outcome (Schneider and Wagemann 2012, 79). We will explain these with concrete examples later. In real life, these conditions occur regularly. While they cannot be adequately tackled with classical comparative methods or large-N quantitative analysis (Blatter et al. 2007, 202ff), QCA provides tools to systematically grasp this complexity.

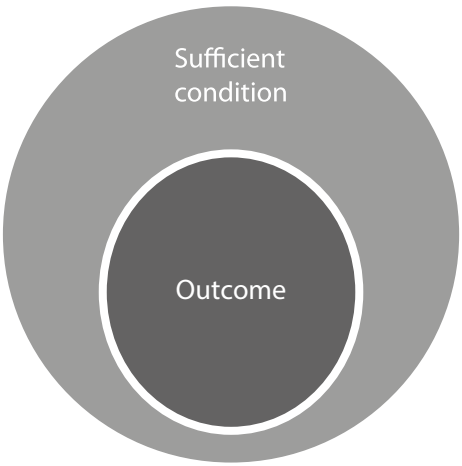

Figure 1. Venn diagram of sufficient conditions.

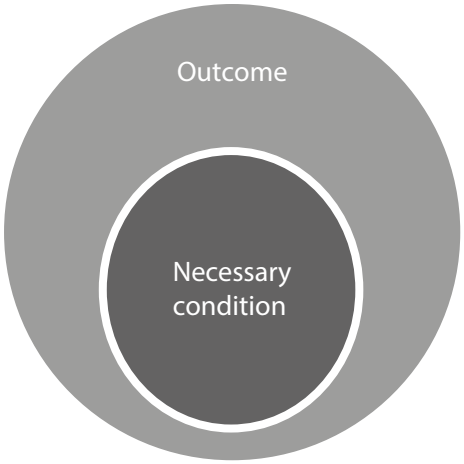

Figure 2. Venn diagram of necessary conditions.

Software

Several software tools have been developed for the application of QCA. Different tools are used to apply different versions of QCA; these versions are explained in detail in the next section.

- QCA-DOS (for crisp-set QCA), developed by Charles Ragin and Kriss Drass in 1992 and updated until 1998 (www.u.arizona.edu/~cragin/fsQCA/software.shtml)
- FSQCA (for fuzzy-set QCA), developed by Charles Ragin, Kriss Drass and Sean Davey in 1999 and continuously updated (www.u.arizona.edu/~cragin/fsQCA/software.shtml)
- TOSMANA (Tool for Small-N Analysis) (for crisp-set QCA and multi-value QCA), developed by Lasse Cronqvist in 2003 (www.tosmana.net/)
- QCA packages for the data analyzing programs Stata and R (http://cran.r-project.org/web/packages/QCA/index.html, http://cran.r-project.org/web/packages/QCA3/index.html and http://cran.r-project.org/web/packages/QCAGUI/index.html for the packages QCA, QCA3 and QCAGUI for R; Longest and Vaisay 2008 for Stata)

Schneider and Wagemann (2012, 282) also give a good synopsis of the different software packages and their features. When analyzing a smaller number of cases with a crisp-set QCA, like the 12-case examples used in this paper, the software is not necessarily needed. However, for a larger number of cases and for fuzzy-set QCA, researchers should use adequate software.

3 The method and its application

During the past 30 years, QCA has been considerably refined and developed, partly in response to criticism of the original version (Ragin 1987). Today, four main methodological variations exist within QCA. These are crisp-set QCA, fuzzy-set QCA, multi-value QCA, and two-step fuzzy-set QCA. In order to illustrate the method and its application, we used the data from Module 1 of GCS-REDD, which analyses national REDD+ processes in 12 countries (Table 1). All are forest-rich tropical developing or emerging countries with a political commitment to implement REDD+ but also with powerful drivers of deforestation, weak multilevel governance, low cross-sectoral horizontal coordination and lack of capacity. These aspects form the joint context of our cases.

The aim of this study was to use QCA to discover, through systematic comparison, under which conditions these countries can successfully implement REDD+, and to develop generalizations and policy recommendations for them and for countries that share their context.To accomplish this, we used an iterative process to select the most relevant factors affecting success or failure in establishing an adequate political framework for REDD+. This process, discussed in depth in Section 4, ultimately yielded six factors.[3] The examples in this chapter are based on the three institutional factors:

1. *Pressure from shortage of forest resources* (PRES): A high share of the country's forest area is under pressure from human activity due to institutionalized patterns of forest use and might soon become unable to meet needs or fulfill usage interests.
2. *Key features of effective forest legislation, policy and governance* (EFF): A legal framework is in place that defines tenure, use and management rights, including both formal and customary regulations. Laws and policies on sustainable forest management and participation are enforced by national and local authorities and complied with by forest users.
3. *Already initiated policy change* (CHA): Policy change addressing climate change and aimed at departing from business as usual, developed independently of REDD+, is already underway – e.g. Nationally Appropriate Mitigation Actions (NAMA), anti-deforestation programs, low-carbon development strategies, and Payment for Environmental Services (PES) schemes.

A successful outcome is defined as the establishment of a comprehensive policy promoting transformational change in the REDD+ policy domain that is likely to lead to successful 3E-REDD+ implementation.

The key factors are all given three- or fourletter codes, and the outcome is represented by the code REDD. For the purpose of this exercise, a case = one country.

Crisp-set QCA (csQCA)

Ragin's original version of QCA (Ragin 1987) is today called crisp-set QCA (csQCA).[4] Its core element is the 'truth table,' a data matrix that contains all values of the causal conditions and outcomes. All conditions are assessed in strictly

Table 1. Countries included in the comparative analysis.

Africa	South America	Asia and Oceania
Burkina Faso	Bolivia	Indonesia
Cameroon	Brazil	Nepal
Democratic Republic of the Congo	Peru	Papua New Guinea
Mozambique		Vietnam
Tanzania		

3 Precise definitions of these factors and the criteria for evaluating them are given in Appendix 1.

4 Especially in older literature, the term QCA is often used to refer to crisp-set QCA.

binary fashion as either absent/false (0) or present/true (1) for the specific case. The threshold between absence and presence is defined for each condition theoretically and assessed based on case knowledge (see Appendix 1). The resulting truth table shows all theoretically possible combinations and their observed presence in the cases.

Table 2 applies this process to the countries chosen for this study.

The table shows that all possible combinations of institutional factors are covered by the cases in our example. The last configuration leads to a contradictory result (C). This means that in one case result 0 and in the other case result 1 is observed.

In total, 2^n combinations of conditions are possible, where n is the number of conditions. Thus, in our example with three causal factors or conditions, 2^3 or eight combinations are possible. The fact that all eight conditions are represented in our empirical cases is an extraordinary situation. Most often, some theoretically possible combinations are not observed in the selected cases. The non-observed configurations are called 'logical remainders.' (Strategies for dealing with these are discussed in 'Empirical diversity' in Section 5.)

In the final configuration, capital letters show the presence of a condition while lowercase letters indicate its absence. The formula of the configuration is achieved with the application of Boolean algebra, in which '+' means 'or' and '*' means 'and.' For example, the configuration for Cameroon would read as follows: PRES*EFF*cha, with the result redd (in other words, Outcome REDD = 0). In less abbreviated form, this could be expressed as follows: Pressure from a shortage of forest resources *and* presence of features of effective forest legislation, policy and governance *and* absence of already initiated policy change leads to absence of a comprehensive policy promoting transformational change in the REDD+ policy domain.

Three combinations lead to a positive outcome: **PRES*eff*CHA** (Indonesia) **+ pres*EFF*CHA** (Vietnam) **+ PRES*EFF*CHA** (Brazil).

These formulas can be further reduced: **pres*EFF*CHA** (Vietnam) and **PRES*EFF*CHA** (Brazil) both lead to REDD; it is obviously irrelevant if PRES is present *in this specific combination* or not.

According to Boolean logic, the combinations **pres*EFF*CHA** and **PRES*EFF*CHA** therefore can be reduced to **EFF*CHA.**

For the other combination (**PRES*eff*CHA** [Indonesia]), PRES stays included; in this context, we have no comparable cases that would indicate it is not necessary. Thus, QCA assesses the impact of each factor according to the case-specific circumstances. Both presence and absence are measured and included in the analysis; absence is not considered irrelevant.

The result of our analysis is thus **REDD = EFF*CHA + PRES*eff*CHA.** In other words, under the framework conditions of our cases successful pro-REDD policies are enabled by the presence of key features of effective forest legislation, policy and governance *and* the presence of already initiated policy change, *or* by pressure from a shortage of forest

Table 2. Truth table, crisp-set QCA

Condition/factor			Outcome	Case/Country
PRES	EFF	CHA	REDD	
0	0	0	0	Papua New Guinea
1	0	0	0	Burkina Faso, Mozambique, Tanzania
1	1	0	0	Cameroon
0	0	1	0	Democratic Republic of the Congo, Peru
1	0	1	1	Indonesia
0	1	0	0	Nepal
0	1	1	1	Vietnam
1	1	1	C	Brazil (1), Bolivia (0)

1 = present, 0 = absent, C = contradictory results

resources *and* the absence of key features of effective forest legislation, policy and governance *and* the presence of already initiated policy change.

It is not important how often a certain combination is found – if it is observed once, it is causal. Concerning necessary and sufficient conditions, it can be concluded that in the joint context of our cases, already initiated policy change (CHA) is a necessary though not sufficient condition for presence of pro-REDD+ policies (REDD). It is a part of all observed configurations leading to REDD. Key features of effective forest legislation, policy and governance (EFF) is an INUS-condition: it is insufficient for the outcome, but a necessary part of the configuration **EFF*CHA**, which is itself unnecessary but sufficient for the outcome REDD.

Fuzzy-set QCA (fsQCA)

One major criticism concerning crisp-set QCA is its binary approach. It requires the assessment of factors as either true or false; there is no room for gradual assessment. Even factors such as economic development, unemployment or age have to be classified as true or false. As a reaction to this criticism, Ragin himself (2000, 2008) developed fuzzy-set QCA. It allows the researcher to define the value of conditions not only in a dichotomous way, but also in gradual variations, and is thus closer to statistical methods.The following description of fuzzy-set QCA is based on Blatter et al. (2007, 215–226) and Ragin's own revised version of fuzzy-set QCA (Ragin 2008, 2009).

Fuzzy sets allow for the possibility of partial membership. Fuzzy-set theory evolved in the 1960s in the natural sciences to tackle uncertainties, where "the boundary of yes and no is ambiguous" (Pennings 2007, 347). In social and political sciences, fuzzy-set theory was used only by a small number of researchers until Ragin (2000) linked it to his QCA concept.

The major difference between crisp-set QCA and fuzzy-set QCA is that, in addition to crisp-set QCA's false/absent or true/present, fuzzy-set QCA also makes possible partial fulfillment of conditions, with values between 0 (non-membership in the set/completely false status) and 1 (full membership in the set/completely true status). This approach allows more differentiation and more precise description. It is up to the researcher to decide how many grades should be used and to define the threshold for each grade. The following is an example of a four-value fuzzy set:

0	=	absent (no membership)
0.33	=	more absent than present
0.67	=	more present than absent
1	=	present (full membership)

The calibration of set membership (the definition of the thresholds between the values) is based on theoretical knowledge, expert judgment and empirical evidence. It can be based on statistical data, but in that case, the data should not be automatically computed but also assessed by the researcher. Their definition has to be transparent and well substantiated. Adequate empirical categorization and definition of thresholds are of critical importance. In principle, the researcher must re-question category boundaries and experiment with them until the analysis is finalized. As fuzzy-set QCA includes more variation among the cases, many scholars argue that more cases are required to establish significant findings (Pennings 2007, 351; Rihoux 2007, 369; see also Schneider and Wagemann 2007; Schneider and Wagemann 2012, 32–41).

Going back to our example, Table 3 shows the assessment of the three conditions as fuzzy sets, with conditions and outcome refined based on a four-value scale.

As the configuration can no longer be represented by a simple formula, the values of the conditions are measured based on the extent to which they are represented in each possible configuration. The configurations can be considered as ideal types. Next, we check which of these ideal types most resembles the concrete assessment of the real cases. For this purpose, each configuration (combination of conditions) is given the value of the condition within it that has the lowest value. For each case there will be only one configuration with a value higher than 0.5, and that one is considered the best fit. Thus, unlike in crisp-set QCA, no case fully represents a configuration. In Table 4, the best fitting configuration is printed in bold. For example, for Mozambique, the value 0.67 is given for the configuration **PRES*eff*cha** because, when looking at the individual conditions, PRES = 1, eff (the absence of EFF) = 1, and cha (the absence of CHA) = 0.67

So far, we have a description of each case but no indication of causal relations. Therefore, in a second

Table 3. Fuzzy-set scores for conditions and outcome.

Case	Condition			Outcome
	PRES	EFF	CHA	REDD
Brazil	1	1	1	1
Bolivia	1	0.67	1	0
Burkina Faso	1	0.33	0	0.33
Cameroon	1	0.67	0	0.33
Democratic Republic of the Congo	0	0.33	0.67	0.33
Indonesia	1	0.33	1	0.67
Mozambique	1	0	0.33	0.33
Nepal	0	0.67	0.33	0.33
Peru	0	0.33	0.67	0.33
Papua New Guinea	0	0	0.33	0
Tanzania	1	0.33	0.33	0.33
Vietnam	0	0.67	1	0.67

Table 4. Fuzzy-set membership of cases in configurations.

Case	Membership in conditions			Membership in configurations							
	PRES	EFF	CHA	PRES*EFF *CHA	PRES*EFF *cha	PRES*eff *CHA	PRES*eff *cha	pres*EFF *CHA	pres*EFF *cha	pres*eff *CHA	pres*EFF *cha
Brazil	1	1	1	**1**	0	0	0	0	0	0	0
Bolivia	1	0.67	1	**0.67**	0	0.33	0	0	0	0	0
Burkina Faso	1	0.33	0	0	0.33	0	**0.67**	0	0	0	0
Cameroon	1	0.67	0	0	**0.67**	0	0.33	0	0	0	0
Democratic Republic of the Congo	0	0.33	0.67	0	0	0	0	0.33	0.33	**0.67**	0.33
Indonesia	1	0.33	1	0	0	**0.67**	0	0	0	0	0
Mozambique	1	0	0.33	0.33	0	0.33	**0.67**	0	0	0	0
Nepal	0	0.67	0.33	0	0	0	0	0.33	**0.67**	0.33	0.33
Peru	0	0.33	0.67	0	0	0	0	0.33	0.33	**0.67**	0.33
Papua New Guinea	0	0	0.33	0	0	0	0	0	0	0.33	**0.67**
Tanzania	1	0.33	0.33	0.33	0.33	0.33	**0.67**	0	0	0	0
Vietnam	0	0.33	1	0	0	0	0	**0.67**	0	0.33	0

step, we want to identify the causal relations between the configurations and the outcome. For this, the requirements differ for necessary and sufficient conditions:

- For necessary conditions, all fuzzy-set scores for the configuration must be equal to or higher than the fuzzy-set score for the outcome.
- For sufficient conditions, the fuzzy-set score for the outcome must be equal to or higher than all fuzzy-set scores for the configuration.

Table 5 shows that in our sample there is no necessary configuration, but a sufficient one: **pres*EFF*CHA.**

Table 5. Necessary and sufficient conditions analyzed by fuzzy-set QCA.

Case	Membership in conditions			Membership in configurations								Outcome
	PRES	EFF	CHA	PRES*EFF*CHA	PRES*EFF*cha	PRES*eff*CHA	PRES*eff*cha	pres*EFF*CHA	pres*EFF*cha	pres*eff*CHA	pres*EFF*cha	REDD
Brazil	1	1	1	**1**	0	0	0	0	0	0	0	1
Bolivia	1	0.67	1	**0.67**	0	0.33	0	0	0	0	0	0
Burkina Faso	1	0.33	0	0	0.33	0	**0.67**	0	0	0	0	0.33
Cameroon	1	0.67	0	0	**0.67**	0	0.33	0	0	0	0	0.33
Democratic Republic of the Congo	0	0.33	0.67	0	0	0	0	0.33	0.33	**0.67**	0.33	0.33
Indonesia	1	0.33	1	0	0	**0.67**	0	0	0	0	0	0.67
Mozambique	1	0	0.33	0.33	0	0.33	**0.67**	0	0	0	0	0.33
Nepal	0	0.67	0.33	0	0	0	0	0.33	**0.67**	0.33	0.33	0.33
Peru	0	0.33	0.67	0	0	0	0	0.33	0.33	**0.67**	0.33	0.33
Papua New Guinea	0	0	0.33	0	0	0	0	0	0	0.33	**0.67**	0
Tanzania	1	0.33	0.33	0.33	0.33	0.33	**0.67**	0	0	0	0	0.33
Vietnam	0	0.33	1	0	0	0	0	**0.67**	0	0.33	0	0.67

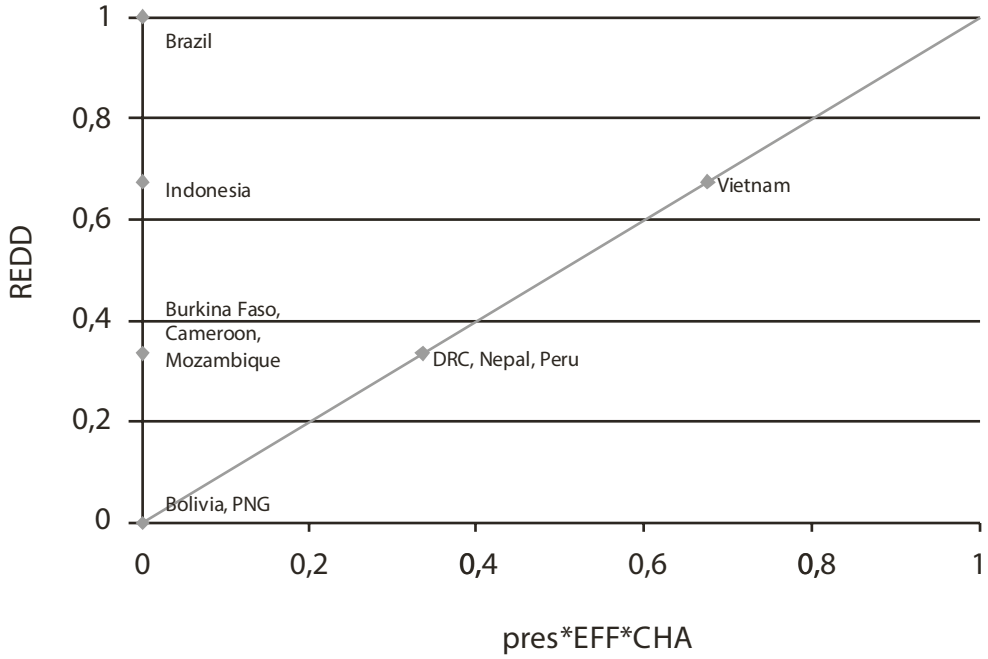

Figure 3. Plot of fuzzy-set scores for outcome REDD and configuration pres*EFF*CHA.

To explain the logic of this process, it helps to visualize the sufficient condition (Figure 3).

For a sufficient condition, all cases have to be located on the diagonal or in the upper left triangle. This means that if the condition is fully present, then the outcome is also fully present, or if the condition is present to the extent 0.33, then the outcome is also present to the extent 0.33. If cases show the outcome without the condition (cases appear in the upper left side rather than on the diagonal line), this is not problematic, because the configuration, while sufficient, might not be a necessary condition (there might be multiple causation). If, however, the condition is more strongly present than the outcome (cases appear in the lower right triangle), then the configuration is obviously not a sufficient cause for the outcome. Unlike in crisp-set QCA, we have established only one sufficient configuration (**pres*EFF*CHA**).

Multi-value QCA (mvQCA)

Multi-value QCA aims to tackle the same key limitation of crisp-set QCA as fuzzy-set QCA does: the obligation to use only dichotomous presence/absence conditions (Cronqvist and Berg-Schlosser 2009). With multi-value QCA, any number of values is possible, which allows inclusion of multi-categorical conditions in the analysis. Ideally, three or four valued conditions should be used (enough for differentiation, but not enough to cease being parsimonious). Yet factors can also remain dichotomous. Often, one or two multi-value conditions are employed while the others are dichotomous. Thus, as Vink and van Vliet (2007, 3) put it, it is "a kind of middle-way between the greater parsimony of crisp-set QCA and the greater empirical richness of fuzzy-set QCA. It is ´not quite crisp´ because it allows the use of intermediate values, but it is also ´not yet fuzzy´ because the outcome is always dichotomous."

This approach allows more differentiation and more homogeneous groupings of conditions than crisp-set QCA, for example, when it comes to conditions such as GDP, unemployment rate or age. But more important, it allows a better grasp of multi-categorical factors such as region, religion, ethnicity, drivers of deforestation, political system, or type of opposition.[5] While factors such as GDP could also be measured by fuzzy-set QCA, such multi-categorical nominal conditions cannot be measured by ordinal scales.

In our example, to illustrate the logic of the analysis in multi-value QCA, we decided to transform the

5 These could also all be grasped in crisp-set QCA, but only as individual conditions, which would increase complexity.

Table 6. Truth table, multi-value QCA.

Case	PRES	EFF	CHA	Configuration	Outcome REDD
Brazil	1	2	1	$PRES_1$*EFF_2*CHA_1	1
Bolivia	1	1	4	$PRES_1$*EFF_1*CHA_4	0
Burkina Faso	1	1	0	$PRES_1$*EFF_1*CHA_0	0
Cameroon	1	1	2	$PRES_1$*EFF_1*CHA_2	0
Democratic Republic of the Congo	0	0	2	$PRES_0$*EFF_0*CHA_2	0
Indonesia	1	1	4	$PRES_1$*EFF_1*CHA_4	1
Mozambique	1	0	3	$PRES_1$*EFF_0*CHA_3	0
Nepal	0	1	1	$PRES_0$*EFF_1*CHA_1	0
Peru	0	1	3	$PRES_0$*EFF_1*CHA_3	0
Papua New Guinea	0	0	0	$PRES_0$*EFF_0*CHA_0	0
Tanzania	1	0	0	$PRES_1$*EFF_0*CHA_0	0
Vietnam	0	2	4	$PRES_0$*EFF_2*CHA_4	1

conditions EFF and CHA into multi-value factors. We redefined EFF into three degrees:

0 = no features of effective forest legislation, policy or governance
1 = some key features of effective forest legislation, policy and governance
2 = sufficient features of effective forest legislation, policy and governance

Herewith, we have more scope of variation to assess the effectiveness of the governance framework. For condition CHA, a multi-categorical differentiation also makes sense:

0 = no previous policy change
1 = previous policy change on climate change (e.g. Nationally Appropriate Mitigation Actions)
2 = previous policy change on anti-deforestation
3 = previous policy change on Payment for Environmental Services
4 = previous policy change in more than one area

PRES and the outcome remain dichotomous.

In principle, the same Boolean algebra and minimization rules are applied. Only the notation is different than in crisp-set QCA, as lowercase and capital letters can reflect only two values. In multi-value QCA, the values are indicated with subscript numbers (Table 6).

We can identify the following causal combinations for the outcome $REDD_1$:
$REDD_1 = PRES_1$*EFF_2*CHA_1 +$PRES_1$*EFF_1*CHA_4 +$PRES_0$*EFF_2*CHA_4.

More differentiation in the conditions reduces the number of contradictory cases (cases with the same configuration but different outcomes). However, the bigger the number of possible values for a condition, the higher the number of possible configurations. Therefore, often (like in our example), no further reductions are possible and 'logical remainders' (logically possible combinations that are not observed in the cases) need to be included in the analysis to achieve parsimony (see Section 5).

Two-step QCA

The newest innovation in QCA is two-step fuzzy-set QCA, developed by Schneider and Wagemann (2006).[6] This method differentiates between remote and proximate conditions (factors), which are then analyzed separately in two steps. Remote conditions are distant in space and time from the outcome, are stable over time and cannot easily be changed by actors. Thus, they are what is often called context. Proximate conditions are close to the outcome in space and time, vary over time and can easily be changed (Schneider and Wagemann 2006; Mannewitz 2011).

6 Schneider and Wagemann used the two-step approach for fuzzy-set QCA, but they viewed the dichotomous conditions of crisp-set QCA as a variant of fuzzy-set QCA. A two-step approach hence certainly can also be applied to crisp-set QCA and multi-value QCA. This is why we speak simply of two-step QCA.

It often depends on the research question and framework whether a factor is considered remote or proximate (Table 7). For example, the forest tenure system can be considered a remote condition if we are interested in how actors act within its framework. But it can be seen as a proximate condition if we look at how a legislature may change the law to ensure effective REDD+ implementation.

In the first step of a two-step QCA, only the remote conditions are analyzed in order to identify 'outcome-enabling conditions.' This produces one or more configurations that are identified as enabling context. In the second step, each step-1 configuration is analyzed together with the identified proximate factors. Thus, several analyses take place in parallel, but only with those cases that show the relevant (outcome-enabling) context. Those remote conditions that proved irrelevant are not considered. This approach thus allows for inferences about which factors play a role if certain context conditions exist.

Figure 4 shows the process of a two-step QCA with seven conditions. Four conditions (A, B, C and D) are defined as remote and three conditions (E, F and G) as proximate. In the first step, analysis of the remote conditions (with the processes described above) leads to the identification of two outcome-enabling configurations: ABd and bC. In a second step, each of the two is separately analyzed with the three proximate conditions; this leads to the final result of four causal configurations.

While fuzzy-set QCA and multi-value QCA were developed to address the problem of binary coding, the aim of two-step QCA is to tackle the problem of limited empirical diversity and therewith the often big number of logical remainders. In our example we have seven factors (A–G); hence, the number of possible variations is $2^7 = 128$. If we then have 30 cases which resemble 28 different observations (i.e. two configurations occur twice), the number of logical remainders is 128–28 = 100. Thus, for 100 logically possible configurations we do not know the outcome, which limits the value and validity of our result. If we apply a two-step approach with four remote and three proximate factors, the number of possible combinations is $2^4 + 2^{3+2}$ ('3+2' refers to the three proximate factors plus the two earlier identified remote conditions). Thus, we have 16 + 32 = 48 logically possible combinations, of which 28 are observed, so that the number of logical remainders is reduced to 20. However, it is clear that the more enabling contexts are identified, the more combinations are possible, and thus there is no longer a substantial reduction of logical remainders (Mannewitz 2011).

Table 7. Definition of remote and proximate factors.

Remote factors	Proximate factors
• Spatiotemporally distant to the outcome	• Spatiotemporally close to the outcome
• Stable over time	• Vary easily over time
• Out of manipulative reach of the actors involved	• Can be manipulated by actors

Source: Schneider and Wagemann 2006; Mannewitz 2011.

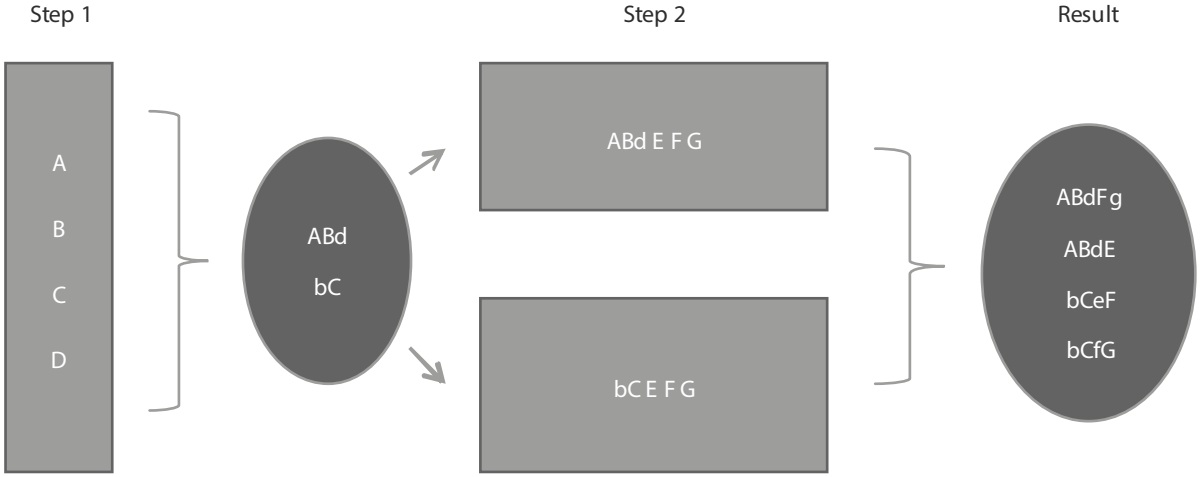

Figure 4. A basic two-step QCA.

Beside the reduction of logical remainders, an additional merit of two-step QCA is that it provides good ground for the analysis of interactions between the two factor levels and for the identification of factors that play a role in a given context.

For the QCA of national REDD+ policy processes, we used the two-step QCA as a crisp-set QCA, in other words using only binary codings. To this end, the three already introduced factors (PRES, EFF, CHA) were defined as remote factors and considered together with three proximate ones:

1. *National ownership* (OWN): National actors are dominant in shaping and supporting the policy discourse on REDD+ and are involved in the development of policy documents. The country is financially committed to REDD+.
2. *Transformational coalitions* (COAL): Policy actors and coalitions exist that can lead policy discussion and formulation in new directions. Agreement among political actors on the importance and content of REDD+ facilitates coalition building.
3. *Inclusiveness of the policy process* (INCL): There is a high degree of participation by and consultation of key stakeholders (including the private sector), civil society and indigenous people. Legal provisions supporting the right of indigenous people and communities to participate are in place.

All six factors are described in detail in Appendix 1.

Table 8 shows the binary values for all six factors.

Step 1, the analysis of the remote factors, is equivalent to the analysis described in the part 'Crisp-set QCA', and yields this result: **EFF*CHA + PRES*eff*CHA.** The next step is to find out which proximate conditions need to be combined with these two enabling configurations of remote conditions. For this step, only those cases that show the enabling factors are included.

Table 9 presents the configurations for remote condition **EFF*CHA.**

Table 8. Truth table for remote and proximate conditions.

Case	Remote conditions			Proximate conditions			Outcome
	PRES	EFF	CHA	OWN	COAL	INCL	REDD
Bolivia	1	1	1	0	0	0	0
Brazil	1	1	1	1	1	1	1
Burkina Faso	1	0	0	0	0	0	0
Cameroon	1	1	0	0	0	0	0
Democratic Republic of the Congo	0	0	1	0	1	1	0
Indonesia	1	0	1	1	1	0	1
Mozambique	1	0	0	1	1	1	0
Nepal	0	1	0	0	1	1	0
Peru	0	0	1	1	1	1	0
Papua New Guinea	0	0	0	0	1	0	0
Tanzania	0	0	0	0	1	1	0
Vietnam	0	1	1	1	1	0	1

Table 9. Truth table for proximate conditions and EFF*CHA.

Case	Remote conditions	Proximate conditions			Outcome
	EFF*CHA	OWN	COAL	INCL	REDD
Brazil	1	1	1	1	1
Vietnam	1	1	1	0	1
Bolivia	1	0	0	0	0

The following configurations for the outcome REDD can be observed: **EFF*CHA*OWN*COAL*INCL** (Brazil) + **EFF*CHA*OWN*COAL*incl*** (Vietnam). These can be further reduced to **EFF*CHA*OWN*COAL**, because the result occurs whether or not INCL is present.

We can thus observe that when some key elements of effective forest legislation, policy and governance, and already initiated policies, exist in combination with national ownership of REDD+ and pro-REDD+ coalitions, comprehensive policies for REDD+ can be established. We can also observe that an inclusive policy process is not necessary for the outcome in this context, because both Brazil and Vietnam have the outcome REDD = 1 although only Brazil has an inclusive process. Also, the contradictory outcomes of Brazil and Bolivia (Table 2) can now be explained: Bolivia has the enabling context, but it lacks the necessary proximate conditions, hence it has outcome 0.

The second combination of remote conditions that leads to the outcome REDD = 1 (**PRES*eff*CHA**) can be observed for only one country: Indonesia (Table 10).

This gives us the configuration **PRESS*eff*CHA*OWN*COAL*incl** for Indonesia. Hence, for Indonesia the same two present proximate conditions as for Brazil and Vietnam can be observed. These are obviously necessary for the outcome notwithstanding the context. Figure 5 shows the process of analysis.

In step 1 we analyzed the three remote conditions and identified two configurations as enabling the outcome REDD = 1: **EFF*CHA** and **PRES*eff*CHA**. In two parallel processes (step 2), we then analyzed each of these configurations separately with the three proximate conditions. As a result, we achieved two configurations as sufficient conditions for REDD = 1. In our study, for both remote configurations almost the same proximate configuration was sufficient. However, with this method we can also determine if, depending on remote conditions, different proximate conditions come to play a role.

Table 11 summarizes the benefits and weaknesses of the different types of QCAs and shows the differences that choice of QCA leads to in the results for our example.

Table 10. Truth table for proximate conditions and PRES*eff*CHA configuration.

Case	Remote conditions	Proximate conditions			Outcome
	PRES*eff*CHA	OWN	COAL	INCL	REDD
Indonesia	1	1	1	0	1

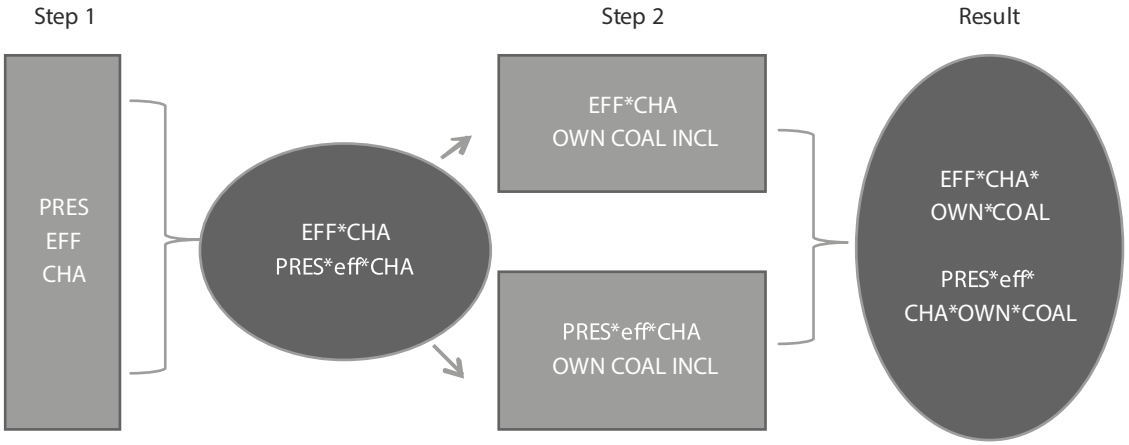

Figure 5. Two-step crisp-set QCA applied to GCS-REDD.

Table 11. Benefits and weaknesses of the different types of QCAs.

Type of QCAs	Benefits	Weaknesses	REDD-enabling conditions identified
Crisp-set QCA (csQCA)	• Easy to conduct • Can be conducted with a small number of cases	• Requires binary values, which may be difficult to define • May oversimplify the reality and results	EFF*CHA + PRES*eff*CHA
Fuzzy-set QCA (fsQCA)	• Allows gradual assessment • Allows better description of the complexity of the factors	• Requires more cases to establish significant findings • May result in a large number of logical remainders	pres*EFF*CHA
Multi-value QCA (mvQCA)	• Allows a better grasp of multi-categorical factors • Allows more homogeneous groupings • Yields fewer contradictory cases	• May result in a large number of possible configurations with many logical remainders	PRES1*EFF2*CHA1 + PRES1*EFF1*CHA4 + PRES0*EFF2*CHA4
Two-step QCA	• Differentiation of factors into remote and proximate often provides a more distinct reflection of social reality and thus strengthens the analysis of interactions between factor levels • Reduces the number of logical remainders • Allows more factors to be considered	• Identification of similar sets of remote and proximate conditions across very diverse country cases can be challenging and may only be possible with extensive country case knowledge	EFF*CHA*OWN*COAL +PRESS*eff*CHA*OWN *COAL*incl

4 Using QCA to study REDD+ policy processes

As shown above, QCA makes it possible to translate complexity in in-depth case studies into reduced and comparable formulas and to formulate inferences on enabling factors. This process can be effectively applied to REDD+, but it requires engagement by country experts and coordinators. This study used QCA both to organize data and to draw inferences from it.

Using QCA to structure data

One use of QCA occurs before the analysis begins: the summarization and coherence check of data. Factors affecting successful implementation of REDD+ were explored thoroughly; the list was then narrowed to a manageable number of the most important factors, and these were operationalized by assigning them indicators by which they could be assessed.

First, we used QCA in a descriptive way to summarize data acquired during 2 years of project implementation by dozens of researchers. In order to get an overview of all factors considered important in the REDD+ process, a preliminary list of potential factors was developed in a workshop with participants from several country teams. This list formed the basis for an online survey conducted among GCS-REDD researchers. It was not a representative survey, but it provided input on the factors relevant for cross-country comparison. In several subsequent steps, including a review of country-specific context studies on REDD+ produced by the country teams (see e.g. Indarto et al. 2012; Pham et al. 2012), these factors were reduced

in number through a process of prioritization and consolidation.

For the comparative analysis, a second round of reduction of factors took place. Eight factors were selected for inclusion in the analysis and operationalized by indicators. The indicators were developed after the first assessments revealed discrepancies in valuation. Their aim was to ensure transparency and comparability of the assessments. The assessment was done by experts from the respective country teams of the GCS-REDD project in a joint workshop, which allowed cross-checking of results. These data provided a reliable and valid basis for starting the QCA, during which the factors were discussed further and changed again – a typical feature of QCA, sometimes referred to as "dialogue with the case"(Rihoux and De Meur 2009, 48). Finally, six factors were chosen as key to explaining the success or failure in achieving 3E REDD+ policy outputs. Analysis was conducted using the software TOSMANA (see above).

The process took several months, but it ensured that intersubjective verifiable data were achieved that respect case specifics but at the same time reduce complexity and are comparable. QCA helped ensure that all country teams shared the same understanding and definition of factors. Putting all data in a truth table and discussing it jointly enabled everybody to get a broad overview of the project and reduced the complexity of the information derived from numerous extensive case studies. It also showed discrepancies in assessments, which could then be clarified. With the definition of indicators, the process ensured that all would have the same understanding and that assigned values would be comparable but still context-sensitive enough to capture reality.

The process is described in more detail in the text below.

Generating a full list of factors

The first workshop produced a list of 14 factors:

1. Already initiated policy change
2. Capacities
3. Economic stability
4. Effectiveness of forest policy and governance
5. Federalism
6. Forestry legislative framework
7. Functioning multilevel governance system
8. Horizontal coordination
9. Inclusiveness of the policy process
10. International engagement
11. National ownership
12. Political commitment to REDD
13. Pressure from shortage of forest resources
14. State autonomy vis-à-vis the political and economic power of drivers of deforestation
15. Transformational coalitions

Shortening the list

The initial 14 factors were presented to key GCS-REDD staff members for prioritization in an online survey. Based on survey results and a further review of the literature, five conditions were removed from the list. 'Horizontal coordination' and 'capacities' were defined as joint context for all countries, as they were assessed as weak in almost all cases.[7] 'Capacities' also overlapped with another factor, 'effectiveness.' Three factors – 'international engagement,' 'federalism' and 'economic stability' – were excluded due to their relatively weak theoretical relation with REDD+ and their lack of prioritization by survey respondents.

The 10 remaining factors were divided into two categories: remote factors (elements of the institutional context) and proximate factors (elements of the policy arena).

Remote conditions:

1. Pressure from shortage of forest resources (PRES)
2. State autonomy vis-à-vis the political and economic power of drivers of deforestation (AUT)
3. Forestry legislative framework (LEG)
4. Effectiveness of forest policy and governance (EFF)
5. Functioning multilevel governance system (GOV)

Proximate conditions:

6. National ownership (OWN)
7. Transformational coalitions (COAL)
8. Already initiated policy change (CHA)

7 The 12 countries analyzed all have in common several factors that are important for the success or failure of REDD+. As they do not differ among the countries, they are not included as causal factors but are the joint context which defines the general setting in which the causal conditions for REDD+ are analyzed. This joint context is that all cases are forest-rich tropical developing or emerging countries with a political commitment to REDD+ but with powerful drivers of deforestation, weak multilevel governance, low cross-sectoral horizontal co-ordination and inadequate capacity – all characteristics that hinder the quick implementation of a 3E REDD+.

9. Political commitment to REDD (COM)
10. Inclusiveness of the policy process (INCL)

Further shortening the list

These were further reduced as follows: PRES was seen as partly overlapping with AUT (in the aspect of economic significance of forests), with AUT being more relevant. Therefore, PRES was excluded. LEG and EFF were seen as closely related as well, as many country experts commented on the lack of effectiveness and implementation of legislation. Therefore, both were combined into a new condition, 'effectiveness of forest legislation, policy and governance' (also coded EFF); four cases in which the values for the two conditions differed were reassessed. OWN was seen as being partly represented by COM and INCL and was assessed as among the least important factors in the online survey, so it was excluded. CHA was also rated low in the online survey; it was as part of a government's political commitment (COM) or even as an outcome rather than a factor. Thus, CHA was excluded as well. As a result of this process, six factors were chosen for the two-step QCA, again divided into remote and proximate conditions.

Remote conditions:
1. State autonomy vis-à-vis the political and economic power of drivers of deforestation (AUT)
2. Effectiveness of forest legislation, policy and governance (EFF)
3. Functioning multilevel governance system (GOV)

Proximate conditions:
4. Transformational coalitions (COAL)
5. Political commitment to REDD (COM)
6. Inclusiveness of the policy process (INCL)

Dialogue with the cases

Next, a first round of QCA – a 'dialogue with the cases' – was conducted. Among the remote conditions, we saw it as necessary to include at least one environmental factor; thus, PRES was reinstated and took the place of AUT (which, as mentioned above, overlapped with PRES); this aspect is now covered from a more natural-resources-oriented perspective. Since GOV had weak values in almost all countries, we decided to consider it as a joint framework condition.

Among the proximate conditions, political commitment (COM) was assessed positive in all the study countries, so we removed it from the list and reinstated national ownership (OWN).

Already initiated policy change (CHA) was also reinstated but defined more strictly as a factor rather than an outcome. And it was redefined as a remote condition, as it is something that happens before REDD+ policies are established and thus is among the preconditions.

These exercises produced the final list of factors, providing the comparable quintessence of two years of intensive case-specific research by almost 50 experts.

Remote conditions:
1. Pressure from shortage of forest resources (PRES)
2. Key features of effective forest legislation, policy and governance (EFF)
3. Already initiated policy change (CHA)

Proximate conditions:
4. National ownership (OWN)
5. Transformational coalitions (COAL)
6. Inclusiveness of the policy process (INCL)

The following conditions were defined as the joint context of all cases:
1. Weak horizontal, cross-sectoral coordination mechanisms
2. Weak multilevel governance systems
3. Lack of professional and financial capacity in forest administration and for monitoring, reporting and verification activities
4. Powerful drivers of deforestation (not relevant to Brazil and Burkina Faso)
5. Political commitment to REDD+ (not relevant to Bolivia)

Using QCA to draw inferences from data

QCA is useful both for structuring data and validating assessments, as described in the previous section, and for analyzing the resulting material to produce tentative answers.

One objective of GCS-REDD is to formulate recommendations for national policy makers about strategies and institutional designs for achieving efficient, effective and equitable REDD+ policy.

Table 12. Consultative process to select factors and indicators.

Activity	Objective	Participants	Result
Workshop	Preliminary list of factors	Country experts from some of the countries represented in the study	Initial list of factors
Online survey	Prioritization of factors	39 respondents from the GCS-REDD project	List of most important and least important factors
Review of country studies	Reduction of the number of factors	QCA team	Shortened list of factors
Review of factors	Reduction of factors and selection of indicators	Global REDD experts and QCA team	Further shortened and operationalized list of factors
Workshop	Assessment of factors based on indicators	Country experts	Assessment of each indicator for each factor
Review of factors and cases	Selection of conditions for analysis	Global REDD experts and QCA team	Final choice, definition and operationalization of factors

These recommendations can be formulated specifically for the countries studied, but in order to make more general recommendations that could apply to other countries, it is important to have a basis for making reliable generalizations. QCA allows such inferences to be made without neglecting the very different case-specific circumstances and the different paths countries may choose to realize REDD+.

Box 1 summarizes the main inferences and results we got from the QCA analysis of GSC-REDD data. As could be shown, with this tool it was possible to identify not only the institutional conditions that need to be in place to achieve successful REDD+ policies, but also which elements of the policy process are needed and how these two levels interrelate with each other.

However, since we have only three cases (Brazil, Indonesia and Vietnam) with the outcome REDD = 1 (in other words, that have established a comprehensive policy targeting transformational change in the REDD+ policy domain), and these had different enabling remote conditions, the inferences we can draw from their comparison are limited; too many possible combinations of conditions are unobserved. Nevertheless, in particular when compared with the combinations leading to outcome REDD = 0 and linking the results to case knowledge (Korhonen-Kurki et al. 2013), some clear inferences can be made. When more countries have established successful REDD+ policies, the new data can be fed into the QCA and we will get a more robust base for inferences.

5 Challenges and limitations of QCA

This section discusses some drawbacks to QCA and the challenges in applying it to GCS-REDD and the REDD+ process.

Selection of cases and conditions

The selection of cases, conditions and indicators has a strong impact on the research results, including conclusions on causal relations, and therefore must be based on careful consideration and strong arguments in order to avoid subjectivity. For this study, the cases were preselected by their inclusion in GCS-REDD, which hindered theory-based case selection, and were low in number. QCA faces the same challenge as all studies with a small number of cases: only a limited number of factors or conditions can be considered if one wants to make valid inferences. The research design involves many factors that are assumed to have an impact; these are complemented by those that evolve from empirical research. It was necessary to reduce the number of factors and to find a theoretically based common definition of cases in order to define them as a sample. The reduction of conditions took place through an extensive participatory process.

A greater variety of cases leads to a greater number of conditions. Less variety enables only limited generalization but provides better grounds for comparison. One possible strategy is to seek cases

Box 1. Insights from two-step QCA for establishing REDD+ in the context of weak governance

Forest governance is weak in most REDD+ countries and can be expected to undermine efforts to establish REDD+. Therefore, CIFOR's QCA study on REDD+ has aimed to identify which preconditions are necessary and/or sufficient for REDD+ to achieve transformational change* in the context of weak governance. Using the two-step QCA, we can notice that only three of the 12 countries achieved outcome 1 (Brazil, Indonesia and Vietnam), and these are divided into two sets of enabling remote conditions (EFF*CHA and PRES*eff*CHA). In step 2 of the analysis, OWN and COAL were observed as necessary proximate factors with both remote settings.

Although the number of cases in step 2 was very limited, by comparing the configurations of these successful cases with those of unsuccessful cases, it is possible to draw some clear inferences about the necessary conditions and different sets of sufficient configurations for comprehensive REDD+ policies to be formulated and implemented.

A crucial institutional factor is having already initiated policy changes, which is a necessary part of both sufficient configurations. Especially in a context of overall weak law enforcement and governance, existing policy change efforts can smooth the path for REDD+. For example, in Vietnam, a path change from business-as-usual approaches was initiated with the launch of pilot Payment for Environmental Services schemes in 2008. Nevertheless, the present analysis shows that this factor alone is not sufficient to enable comprehensive REDD+ policies, but must be accompanied by either key elements of effective forest legislation, policy and governance (as in Brazil and Vietnam) or by high pressure from a shortage of forest resources (as in Indonesia). As the case of Peru shows, even in the presence of national ownership and transformational coalitions, REDD+ policy development will not be successful if no enabling institutional preconditions other than prior policy change are in place.

Among the policy arena conditions, national ownership and transformational coalitions are necessary conditions and when in combination with both outcome-enabling remote configurations they are sufficient for outcome. All the successful countries have strong national ownership of their REDD+ policy processes. All three successful cases are also characterized by the presence of transformational coalitions. The present analysis indicates that the inclusiveness of policy processes plays only a minor role. Countries that have centralized and relatively authoritarian systems (e.g. Vietnam) or that have strong national leadership over the process (e.g. Indonesia) have successfully established the necessary foundations for effective REDD+ even though the process is not inclusive.

To conclude, these results indicate path dependencies and institutional stickiness in all the study countries. Only countries already undertaking institutional change have been able to establish REDD+ policies in a relatively short period – but only in the presence of either high pressure from forest resource shortages or key features of effective forest legislation, policy and governance. Furthermore, where an enabling institutional setting is in place, the policy arena conditions of national ownership and transformational coalitions are crucial. When these proximate conditions did not have the enabling remote setting, they did not lead to a successful outcome.

* 'Transformational change' is understood here as a shift "in discourse, attitudes, power relations, and deliberate policy and protest action that leads policy formulation and implementation away from business as usual policy approaches that directly or indirectly support deforestation and forest degradation" (Brockhaus and Angelsen 2012, 16–17).

Source: Korhonen-Kurki et al. (2013).

that share features or have a similar context, so that many factors are controlled for. In the GCS-REDD context, it was important to find a clear definition of the countries included in the analysis that also makes the range of possible inferences clear.

Empirical diversity

Related to the classical problem of too few cases and too many variables is the challenge of limited empirical diversity. With 12 cases, GCS-REDD is at the lower limit of adequate cases for QCA. As outlined above, 2^n possible combinations of conditions need to be checked, where n = the number of conditions. Ideally, all these possible combinations would be observed and analyzed. But this is hardly ever the case, so that for some combinations of factors, the truth table will not show any cases. Some combinations are simply not possible for logical reasons – for example, a high coverage

of tropical rainforests in the northern hemisphere, or an authoritarian regime with a high degree of stakeholder participation. Others are historically implausible – for example, a powerful role for private forest businesses and a high degree of equitable benefit sharing with indigenous people. But even if these are excluded from the analysis, a number of combinations of conditions usually remain that are possible but do not occur in the sample ('logical remainders'). We do not know whether or not these would lead to the outcome, and this restricts the validity of our inferences.

The best way to reduce the number of logical remainders is to select as few conditions as possible. As a matter of fact, their number is higher in fuzzy-set QCA and multi-value QCA, as conditions can have more than two values and thus more combinations are possible. Schneider and Wagemann (2006) saw it as a virtue that the researcher is forced to think about nonexistent cases, but conceded that no really convincing solution to the problem of logical remainders existed. Therefore, they developed the two-step fuzzy-set QCA approach described above. Blatter et al. (2007, 210ff) proposed several solutions to reduce the number of logical remainders, although they considered none of them really satisfying:

- *Most parsimonious solution:* For all outcomes values are chosen (with computer simulation by software) so that the most parsimonious reduced formula is obtained.
- *Blanket assumption:* All outcomes are treated as if they showed the outcome 0, and only empirically observed cases are included in the analysis.
- *Thought experiment:* The outcome is assessed based on theoretical assumptions by the researcher.

The problem is less relevant if we want to make only statements about the cases we observed and accept that the result will be more complex, but it is more relevant if we want to make more parsimonious and generalized statements.

In our study, $2^3 + 2^{3+2}$ combinations are possible (see the discussion of two-step fuzzy-set QCA in Section 3). Of these 8 + 32 = 40 logically possible combinations, only 12 were observed. This problem was in particular relevant for the analysis of the proximate factors in the two-step QCA, as only three countries had a positive outcome and could be included in the comparison. Thus, while all eight possible combinations of the remote factors were evident, of the 32 possible combinations of the proximate conditions with the two remote conditions, only four could be observed. In principle, this was not enough to make meaningful inferences. While these two challenges in principle apply to all QCA applications, other problems occur specifically with certain types of QCA or research settings.

Binary coding (csQCA)

The original version of QCA (crisp-set QCA) makes it necessary to dichotomize all factors – every condition has to be assessed as either being fully present (1) or fully absent (0). This does not allow gradual assessment. Critics argue that many social and political phenomena are too complex for a binary assessment (Pennings 2007, 347) – such as economic development, unemployment and poverty (in the REDD+ context, this could be participation, corruption or forest degradation). On the other hand, proponents of crisp-set QCA argue that differences in kind are more interesting and explanatory than differences in grade. In any case, binary coding leads to a loss of information, and it creates the often difficult challenge of defining only one threshold. This definition has to be theory based and empirically validated, but it leaves room for subjectivity and probably can be questioned in many cases.

During discussions with GCS-REDD country team experts on the assessment of the conditions, many said it was challenging to assess complex factors, such as national ownership or the effectiveness of forest governance, in binary terms. We responded by refining the indicators and making the assessments transparent. Nevertheless, sometimes rather different country situations were assessed with the same value.

Static character versus dynamic process

REDD+ is a highly dynamic process that may not be fully captured with a static QCA snapshot. Unlike many studies, GCS-REDD analyzes not a finished process but ongoing processes in which actor constellations, institutional settings and policy priorities constantly change. In most countries, this process has been taking longer than anticipated, and REDD+ policies have not yet been developed and are far from being implemented. This means that the final outcome cannot be assessed yet and thus had to be redefined. This is a challenge for every analytical method, including QCA.

Case-study research usually emphasizes process, but QCA, despite being a case-oriented method, has been accused of being static (De Meur et al. 2009, 161–163). However, although the minimal configuration might seem static, it has to be interpreted based on the in-depth case knowledge that underlies it. In addition, sequencing and process can be included in the definition of the causal conditions. A country case can also be separated into different time periods as subcases. Nevertheless, these are only limited approaches compared with the complex analysis of path dependencies, feedback processes, and similar elements that can be tackled within case studies with tools such as narrative analysis or process tracing. If the time dimension needs to be more explicitly addressed, QCA can be combined with other methods such as sequence analysis, comparative narrative analysis, or optimal matching (Rihoux 2007, 376ff). Caren and Panofsky (2005) developed a model to integrate the time dimension directly into QCA and called it temporal QCA, but to the authors' knowledge there has been no application of it so far. In the GCS-REDD context, it certainly would be beneficial to conduct another QCA at a later point, when more countries have made progress in establishing REDD+ policies.

6 Benefits of QCA

As mentioned earlier, QCA is an approach as well as a methodological tool. As an approach, it serves the cognitive interests of social science. Its central principles – multiple and conjunctural causation, identification of necessary and sufficient conditions and their combination – better reflect social reality and complex social science thinking than do statistical methods (Blatter et al. 2007, 204). Especially the notion of equifinality – that there are different but equally effective ways to reach an outcome depending on the specific context – is a much observed phenomenon. Yet conventional social science methods have not been able to capture equifinality due to their focus on identifying a single causal path (Fiss 2010, 759).

As a method, QCA allows researchers to better understand complex causal relationships among a larger number of cases. With truth tables, the complexity of cases is reduced to specific configurations. This makes systematic comparison possible and provides better data visualization (Blatter et al. 2007, 201) while preserving the identity of the case. The "half verbal-conceptual and half mathematical-logical" QCA language (Fiss 2010, 758) allows clear formulation of the relation between causes and outcomes.

The need to categorize data requires researchers to be transparent about coding and to justify their decisions. QCA requires a constant "dialogue with the case" (Rihoux and De Meur 2009, 48) or "dialogue between ideas and evidence" (Ragin 1987), for example in case ofcontradictory configurations (Rihoux and De Meur 2009, 48–56). It is the opposite of most of the more advanced statistical tools, which feed data into a 'black box' and then produce a result. It constantly demands choices from researchers which they have to justify and make transparent.

Even the problem of contradictory cases, which many researchers encounter, has a positive effect: it forces researchers to learn from these contradictions as they show either that empirical cases have not been adequately assessed or that an important factor has been forgotten (Rihoux 2007, 375). In our example, a contradiction occurred during the first round of analysis between Brazil and Bolivia, which had the same configuration but different outcomes. In that case, the different outcomes were easy to explain with the different proximate conditions. In other instances, the dialogue with the cases and the results of the first round of QCA caused us to challenge the original selection of factors and redefine it (see Chapter 4).

To sum up, QCA can be a useful tool for several purposes (Rihoux 2007, 368; Berg-Schlosser et al. 2009, 15ff):

- *Summarizing data:* Putting all data into a truth table can make it easier to explore similarities, clusters, patterns, and differences among cases.
- *Checking data coherence:* In the first QCA of data, contradictory cases often occur. This forces researchers to delve deeper into the cases and causal arguments and helps them to formulate a coherent causal chain.
- *Testing existing theories and assumptions:* QCA can be designed to falsify existing theories – for example, when conditions measure the assumptions but show a large number of contradictory cases.
- *Testing new ideas, assumptions, and conjectures:* QCA can be used in an exploratory way to test an assumption in a certain number of cases and then develop it further.
- *Developing new assumptions or theories:* The conjectures obtained by QCA can be used and interpreted to develop new theoretical arguments.

7 Conclusions

QCA enables systematic cross-case comparison of an intermediate number of case studies. Applying QCA to CIFOR's Global Comparative Study on REDD+, we showed how it could help to derive parsimonious and stringent research results from a multitude of in-depth case studies and participating researchers. QCA is a time-consuming process, in particular when many researchers are involved. It requires commitment and readiness to question and reflect repeatedly on the assessments made. This occurs first in exchange with other country experts who may have conflicting assessments based on other sources of knowledge, which then have to be discussed in order to achieve a final assessment, and second when experts of one country see their assessments in contrast to other countries' experts, and a process of calibration is needed across the different countries. The value of QCA in addressing such challenges is twofold:

1. QCA is a structuring tool that enables researchers to share understanding and produce coherent data. Country experts are required to compare their case assessments with the situation in other countries and consequently can set their case knowledge in relation to other cases. Project coordinators and researchers on a global level who do not have this specific case knowledge can strengthen their overview of all cases and can identify ways to streamline research, while they also gain insight into case specifics.
2. QCA is a tool for making inferences usable for policy advice. In the context of REDD+ national policies, for example, the result of the two-step QCA indicate that the societal and political change needed to implement REDD+ requires time and needs to be supported by broad political coalitions. Furthermore, it is important that each country has ownership of its own REDD+ process and decides how REDD+ will be implemented; international actors' roles should be advisory.

REDD+ is still a young policy domain and a very dynamic one. Currently, the benefits of QCA mainly result from the fact that it helps researchers organize evidence. However, with further and more differentiated case knowledge, as well as with more countries achieving a desired outcome, QCA has the potential to deliver robust analysis that allows the provision of information, guidance and recommendations to ensure carbon-effective, cost-efficient and equitable REDD+ policy design and implementation.

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Appendix 1. Definitions and indicators of outcome and conditions

Outcome: Establishment of a comprehensive policy targeting transformational change in the REDD+ policy domain

Presence	Absence	Indicators of presence	Evaluation
New institutions, procedures and capacity-building measures are established by committed actors. These institutions and procedures support concrete policy formulation and outputs. Such policies and outputs are built on a broad societal consensus for change.	New institutions and procedures are not established or are met with resistance, thus undermining their capacity to function. REDD+ policy formulation remains fragmented or is undertaken mainly by external actors. Business-as-usual approaches dominate media and politics.	• A monitoring, reporting and verification system has been developed. • A coordination body has been established. • REDD financing is used effectively. • A national strategy is in place. • An accountability system for REDD+ has been established.	Two or more indicators of presence = 1 Zero or one indicator of presence = 0

Conditions

Presence	Absence	Indicators	Evaluation
Pressure from shortage of forest resources (PRES)			
Forests are under pressure from a high deforestation rate.	Forest resources are abundant or recovering; deforestation is low to medium, or reforestation is occurring.	• Forest transition stage[8] • Deforestation rate	Forest transition stage 2 or 3 and deforestation rate above 0.5% annually = 1 Forest transition stage 1, 4 or 5 and deforestation rate below 0.5% annually = 0
Key features of effective forest legislation, policy and governance (EFF)			
A sound and clear legal framework with clearly assigned rights and management regulations is in place. Laws and policies are at least partly effectively implemented by national and local administrations, which have at their disposal a minimum of enforcement mechanisms and implementation capacity.	Tenure and rights are in many respects unclear and contested. There are unresolved contradictions between formal and customary law. Adequate laws and policies do not exist, or they exist but are ineffective because of lack of implementation mechanisms and enforcement capacity and/or elite capture and corruption.	• A sound and consistent legal forestry framework and policies are in place. • Effective implementation and enforcement mechanisms are in place. • Capacity-building efforts for implementing agencies are conducted. • There is high compliance with the law by citizens and businesses. • Forest users as well as officials are aware of rights and able to use them effectively. • There is a low level of corruption, and clientelistic patterns rarely undermine policy implementation.	Two or more indicators present = 1 Zero or one indicator present = 0

8 The forest transition theory defines five stages in forest cover change: (1) High forest cover, low deforestation rate; (2) High forest cover, high deforestation rate; (3) Low forest cover, high deforestation rate; (4) Low forest cover, low deforestation rate; (5) Low forest cover, negative deforestation rate (Angelsen et al. 2009, 4).

Presence	Absence	Indicators	Evaluation
Already initiated policy change (CHA)			
The government has already formulated and is implementing policy strategies on climate change (e.g. Nationally Appropriate Mitigation Actions) and deforestation, or a low-carbon development strategy and/or Payment for Environmental Services schemes are already established.	The government has not yet formulated substantive policy strategies on climate change (e.g. Nationally Appropriate Mitigation Actions) and deforestation or a low-carbon development strategy, or existing policies are highly insufficient or not implemented. No Payment for Environmental Services schemes have been established.	• There is evidence of implementation of policy strategies in related fields (e.g. one or more of the following: Nationally Appropriate Mitigation Actions, Payment for Environmental Services, deforestation, low-carbon development).	Present = 1 Absent = 0
National ownership (OWN)			
Pro-REDD+ media statements are made by national and subnational governments. National research and NGO actors dominate policy discourse (media analysis). National political institutions are engaged in REDD+ policy formulation. Donor agendas do not dominate the process. There is an adequate budget allocation to REDD+.	Anti-REDD+ media statements by national state actors and/or pro-REDD+ statements by international actors dominate policy discourse. Policy formulation is mainly carried out by foreign actors. Financial incentives from donors are the main reason for REDD+ implementation. There is no budget allocation to REDD+.	• Regular pro-REDD+ statements by government appear in the media. • REDD+ policy formulation is led by national political institutions. • Foreign donors and actors have only a minor or advisory role and agenda in REDD+ policy formulation.	All three indicators present = 1 Fewer than three indicators present = 0

Presence	Absence	Indicators	Evaluation
Inclusiveness of the policy process (INCL)			
Key stakeholders, including civil society, private sector and indigenous people (if applicable) participate or are at least consulted during the REDD+ process. There are formal participation or consultation mechanisms, and the views expressed by stakeholders are considered in REDD+ policy documents.	There are no formal mechanisms for participation by or consultation with key stakeholders, civil society, indigenous people and the private sector, or existing mechanisms are not applied. Stakeholders' views are not represented in REDD+ policy documents.	• Key stakeholders (civil society, private sector, indigenous people) participate or are at least consulted during the REDD+ process. • Formal and effective participation mechanisms have been developed and are present. • The results of and views expressed during the consultation process are included in REDD+ policy documents. • There is knowledge about REDD+ at the local level.	Two or more indicators present, including one of the last two indicators = 1 Zero or one indicator present, or neither of the last two indicators = 0
Transformational coalitions (COAL)			
Coalitions of drivers of change exist and have room to maneuver in the political structures and affect the discourse. Policy actors and coalitions calling for transformational change are more prominent in the media than those supporting the status quo.	There are no observable coalitions of drivers of change, or those that exist are too marginal to influence policy-making and are not visible in the political discourse on REDD+. Media and policy circles are dominated by coalitions supporting the status quo.	• There is some degree of coalition building among actors supporting REDD+ policies (e.g. umbrella organization, regular meetings, joint statements, personal relations). • There are drivers of change (policy actors who lead discourse in a pro-REDD+ direction) both inside and outside government institutions. • Policy actor coalitions calling for substantial political change in forest policies are more prominent in the media than those supporting the status quo. • Pro-REDD+ policy actors have good access to political decision-makers (e.g. are invited to expert hearings, serve as members in advisory councils).	Two or more indicators present, including the first indicator = 1 Zero or one indicator present or first indicator absent = 0

***CIFOR Working Papers* contain preliminary or advance research results on tropical forest issues that need to be published in a timely manner to inform and promote discussion. This content has been internally reviewed but has not undergone external peer review.**

This working paper gives an overview of Qualitative Comparative Analysis (QCA), a method that enables systematic cross-case comparison of an intermediate number of case studies. It presents an overview of QCA and detailed descriptions of different versions of the method. Based on the experience applying QCA to CIFOR's Global Comparative Study on REDD+, the paper shows how QCA can help produce parsimonious and stringent research results from a multitude of in-depth case studies developed by numerous researchers.QCA can be used as a structuring tool that allows researchers to share understanding and produce coherent data, as well as a tool for making inferences usable for policy advice.

REDD+ is still a young policy domain, and it is a very dynamic one. Currently, the benefits of QCA result mainly from the fact that it helps researchers to organize the evidence generated. However, with further and more differentiated case knowledge, and more countries achieving desired outcomes, QCA has the potential to deliver robust analysis that allows the provision of information, guidance and recommendations to ensure carbon-effective, cost-efficient and equitable REDD+ policy design and implementation.

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