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REGULAR RESEARCH ARTICLE

Ostrom's Design Principles as Steering Principles for Contractual Governance in "Hotbeds"

Taufik Haryanto[1], Josephine van Zeben[2], and Kai Purnhagen[3]

AFILIATIONS

1. PhD candidate at Wageningen University, Wageningen, the Netherlands
2. Chair of the LAW group at Wageningen University, Wageningen, the Netherlands
3. Chaired Professor of Food Law at Faculty of Life Science and Faculty of Law, University of Bayreuth, Bayreuth, Germany

Correspondence:
taufik1.haryanto@wur.nl

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ABSTRACT

The sustainability of complex contractual governance in "hotbeds" depends on steering principles. Ostrom's design principles provide an analytical framework for robust institutions that enable collective action and cooperative behaviour. The success of Ostrom's design principles depends on the capacity of social entities to self-govern. This article explores the potential of Ostrom's design principles as such steering principles for contractual governance in "hotbeds". We find that the preconditions for successful contractual networks in "hotbeds" and the empirical situations underlying Ostrom's design principles are comparable. Building on this comparability, we apply Ostrom's design principles to contractual networks in "hotbeds" area theoretically, and then go on to demonstrate its applied value to three situations in West Papua, Indonesia.

KEYWORDS

contractual networks; Ostrom's design principles; West Papua; Indonesia; governance

1. INTRODUCTION

In West Papua, Indonesia, several local contractual networks are in place to manage the maintenance of biodiversity and establish the sustainable use of nature. These contractual networks in West Papua feature mainly as a social institution. As such, the inherent trust-building mechanism among the members of the network may also work as an enforcement tool for existing right of use regimes. They formalise existing rules on exercise of collective rights in local groups. This makes it more difficult for other parties to contract out rights of use such as logging rights with only one member of the eligible group. They also determine the exercise of rules of use for common pool resources of local groups with other partners. Thereby, they provide a legal default position to rely upon when the exercise of rights of use is unclear (e.g., fishing). This enforcement function of contractual networks is particularly important in areas where public enforcement is weak.

Haryanto and Purnhagen have illustrated that contractual networks have the potential to function as substitutes for public regulation in social and political hotbeds (Haryanto & Purnhagen, 2019). Past research finds that "hotbeds" are particularly likely to share these features, and contractual networks are often used to manage sustainable use of natural resources (Haryanto & Purnhagen, 2019). Such contracts hence display regulatory features in a governance framework (Haryanto & Purnhagen, 2019). The regulatory function of a networked contract is determined by the contracts' ability to enable a type of "social glue" as a cooperative feature (Macaulay, 1963; Bradach and Eccles, 1989; Satria et al., 2006; Gómez & Cafaggi, 2011). Social glue is a social mechanism to keep institutions connected over time. Trust can serve as an important example in this regard. In such complex social relationships with multiple stakeholders involved, the issues associated with long-term contractual network arrangements are

particularly relevant.

In order for such governance frameworks to function in "hotbeds", collective action among stakeholders has been identified as the most promising governance feature in contractual networks (Haryanto & Purnhagen, 2019). The success of collective action depends on the willingness of stakeholders to cooperate towards a common goal (Lundqvist, 2001; Pretty, 2003; Marshall, 2004), such as sustainable use of natural resources. This cooperation often relates to expectations of others' behaviour; trust can lead to reciprocity and expectations of desired behaviour. Thus, trust can be crucial to determine such cooperation (Ostrom, 2010). Cooperation often relies on the existence of a "social glue" rather than formal (state-centred) regulation (or at least the mix between them) as this form of compliance can enable successful collective action.

The literature has defined features which determine the success of collective action and compliance in nature management as follows: The degree of participation (Pomeroy & Berkes, 1997; Degnet et al., 2020); access (Ribot & Peluso, 2003); incentives (Chaudhary et al., 2015); and empowerment (Krott et al., 2014, Naiga et al., 2015). In addition, characteristics connected to stakeholders such as local norms (Vollan et al., 2013), locally organized rules-in-use (Agrawal, 2001a; Cinti et al., 2014), and cultural aspects (Sikor & Lund, 2009) have proven relevant. The hybrid governance of top-down and bottom up has also been explored which shows different success stories of both approaches (Sterling et al., 2017). Decisive factors include community involvement (Pomeroy & Berkes, 1997), willingness to cooperate (Cavalcanti et al., 2010), functioning rules (Vollan et al., 2013), legitimation, and equitability (Andersson et al., 2014, Naiga et al., 2015). In a previous study, the authors have shown that based on this literature, the success of collective action, and hence the realization of the regulatory function of contracts, is largely determined by whether the contractual relationship is governed by common steering principles, which incentivize cooperation (Haryanto & Purnhagen, 2019). In hotbeds, such as the ones we are discussing here, such steering principles need to be disconnected from state-centred regulation (Haryanto & Purnhagen, 2019).

2. METHODS, HYPOTHESES, CONCEPTS AND DEFINITIONS

In this paper we contribute to theory-building (Shepherd & Suddaby, 2016) in the area of institutional law and economics by using the tool of interdisciplinary communication (Holbrook, 2013) communicating between contractual network theory and Ostrom's design principles theories. In that respect, action-situation from both theories are being compared and tested to answer the following two research questions: First, can Ostrom's design principles serve as steering principles for functioning contract governance frameworks (Part I)? Second, how can they be embedded into contractual networks (Part II)? Ostrom's design principles, derived from robust self-organized institutions for sustainable resources, do not focus on specific rules but on underlying theoretical arguments to match the rules of the system to the biophysical condition and community characteristics (Ostrom, 2005b). While design principles are not a blueprint or panacea for governance (Cox et al., 2010), they provide a good departure point to find appropriate means for solving governance problems (Ostrom, 2005b).

We apply the hypotheses that derive from these two research questions to the case study of Indonesian West Papua, where local network contracts are in place to manage the maintenance of biodiversity and establish the sustainable use of nature (Part III). Indonesian Papua is the western part of New Guinea island. The land is divided into two administrative provinces: Papua on the eastern part (31,3 million hectares) and West Papua on the western part (9,8 million hectares) (Gaveau, 2019). Representing around 34,4% of the country's forested land, Indonesian Papua is the most densely forested region in the country (MoEF, 2019). Around 85,3% of the land in West Papua is covered by forest (MoEF, 2019). The province of West Papua is the only province in Indonesia that declares itself as a province of conservation (Syartinilia et al., 2019). Traditionally, Papuan people have their own system to organize resources, either in a communal way (based on clan), or famil(ies) and even individual ownership (Mansoben, 1994). State regulations in organizing resources have created some conflicting interests in authority (Fatem et al., 2018) and the rights to use (Morawetz, 2017). Despite those different regulatory exposures, local initiatives to organize the resources remain and/or re-emerge with old and new stakeholders involved (McLeod et al., 2009, Agostini et al., 2012; The Samdhana Institute, 2017). The final section of the paper concludes and makes recommendations for further research.

Within this paper, we use the following concepts and definitions in the subsequent way. **Contractual networks** describe the sum of interrelated contracts among stakeholders, which are designed to confer the benefit of cooperation to achieve a common objective without creating a new entity (Haryanto and Purnhagen, 2019; Cafaggi, 2011, Teubner & Collins, 2011). Contractual networks is used by legal scholars as an analytical concept to explain economic activity where stakeholders agree an exchange of property or services to achieve necessary coordination in order to manage adaptation to changing conditions (Teubner, 2011). To achieve a common objective, cooperation between stakeholders needs to be secured. Securing cooperation is a crucial issue in circumstances where: behaviour is multidimensional; there is uncertainty around actions and outcomes; partners are in a long term commitment; contract performance is influenced by future contingencies; the value of interaction may change; and there is constant risk of renegotiation (Gómez & Cafaggi, 2011). Contractual networks provide informal governance structures that rely on other social institutions and social norms (Gómez & Cafaggi, 2011), particularly (in relational contracts) on trust (Macneil, 1973). For contractual networks to effectively act as a substitute, there needs to be functioning governance mechanisms, which steer the web of relationships in the desired direction. **Political and social "hotbeds"** are "rural areas in countries such as Colombia, Brazil, Madagascar, Tanzania, Malaysia, Indonesia, and the Ivory Coast which often feature high levels of poverty, insecure land tenure and landlessness, unstable and/or undemocratic political systems, and histories of state-sponsored repression" (Brechin et al., 2002). Subsequently, we will refer to both, political and social "hotbeds" only as "hotbeds". **Steering principles** are optimization commands which define the direction in which behaviour in contractual networks shall be guided. **Design principles** describe condition or elements for a robust self-organized institution to govern resources (Ostrom, 1990) . **Institutions** are understood as rules that human use to organize repetitive and structured interaction at multiple levels of analysis (Ostrom, 2008b). **Social entities** is understood as an immaterial product of a community where its existence involves a network of relations with others in the community (Masolo et al., 2004). **Trust** is understood as a mean to reduce uncertainty

and vulnerability. It plays an essential role in the functioning of societies (Cook, 2001). Collective actions are efforts of two or more individuals or agents to accomplish an outcome (Sandler, 2015).

3. THEORY BUILDING ON OSTROM'S DESIGN PRINCIPLES AS STEERING PRINCIPLES FOR CONTRACTUAL NETWORKS IN HOTBEDS

Based on empirical work in local communities, Elinor Ostrom developed eight design principles (Ostrom, 1990), which she considered to be necessary requirements for collective action through self-organization of Common Pool Resources (CPR) (Cox et al., 2010). This section will elaborate whether Ostrom's findings can be extrapolated to also govern network contracts in hotbeds. We will first introduce Ostrom's design principles before we elaborate on their transferability to network contracts.

3.1. Ostrom's Design Principles – A Primer

Ostrom developed her design principles as a response to Hardin's findings of the "Tragedy of the Commons" (Hardin, 1968). Hardin identified free riding as a major non-cooperative behaviour in the self-organization of CPR (Hardin, 1968). As a solution, he included stronger and stricter governance frameworks in his recommendations (Næss, 2004, Hardin, 1968). Ostrom designed her principles with a view to significantly limit free riding in such institutions (Ostrom, 1990). Her work characterizes "the efficacy of multiple types of rules and sets of rules" for cooperative behaviour in such collective action institutions (Cox et al., 2010). This includes in particular self-governing institutions; accordingly her research concerned the provision of diagnostic tools for robust and long enduring institutions of self-governance (Ostrom, 1990; Carter & Weible, 2014). Rather than coercion, these institutions depend on the capacity of social entities to self-organize (Kooiman, 2003; Minato et al., 2010). For these to work, local relationships and local institutions play an essential role in stimulating trust to enable cooperative behaviour (Eshuis & Van Woerkum, 2003; Blomkvist & Larsson, 2013).

Based on a selection of empirical work from CPR, which had assessed several localities, Ostrom formulated eight design principles, as described by Ostrom (Ostrom, 1990) and as reviewed by Cox (Cox et al., 2010) in table 1 below.

Table 1. Ostrom's design principles

	Principle	Description
1	Clearly defined boundaries	This principle stipulates two kind of boundaries, which are the boundary of stakeholders and the boundary of the resource system itself (Cox et al., 2010; Ostrom, 2008a; Ostrom, 1990; Ostrom, 2009; Ostrom, 2005b). The boundary of stakeholders explains who has the right to enter, harvest, or manage the resource, and thus who has a function of user excludability (Cox et al., 2010). The boundary of resource internalizes allocated resource systems (Cox et al., 2010).
2	Congruence	Two types of congruence are distinguished: Congruence between rules-in-use and local social and environmental conditions, as well as congruence on cost and benefit to make such rules-in-use, such as labor, material, or money (Cox et al., 2010, Ostrom, 2009, Ostrom, 2005b). Rules-in-use need to conform to local conditions as well as proportional cost. The benefit must be well accepted and receive legitimacy from the affected stakeholders (Ostrom, 2005b).
3	Collective choice or participatory	Stakeholders that are affected by the operational rules need to participate in the modification of the governing rules (Ostrom, 1990).

Principle		Description
	arrangement	Such participation will likely create rules that are suitable to local conditions and considered as fair (Ostrom, 2009; Ostrom, 2005b).
4	Monitoring	The biophysical condition of the system and appropriators' behaviour must be monitored (Ostrom, 2009; Cox et al., 2010; Ostrom, 2005b). Monitors are at least partially accountable to or are the appropriators themselves (Cox et al., 2010; Ostrom, 2005b). The accountability of monitoring ensures the effectiveness of the rules enforcement mechanism (Ostrom, 2005b).
5	Graduated sanction	Stakeholders who violate the rules are likely to receive graduated sanction (depending on the context and seriousness of the offense) from other stakeholders or the official. Graduated sanctions are accountable. (Cox et al., 2010; Ostrom, 2005b).
6	Conflict resolution mechanism	Stakeholders need to have easy access to and low-cost mechanisms for resolving conflict (Cox et al., 2010, Ostrom, 2009, Ostrom, 2005b).
7	Recognition of local rights to organize	The rights of stakeholders to govern their own institutions is recognized and is not challenged by higher authorities (Ostrom, 1990; Ostrom, 2009; Cox et al., 2010; Ostrom, 2005b).
8	Nested enterprises (for institutions that are part of a larger system)	"Appropriation, provision, monitoring, enforcement, conflict resolution, and governance activities are organized in multiple layers of nested enterprises."(Ostrom, 1990). They respond to both horizontal and vertical linkages of the multi-level governance systems (Cox et al., 2010).

Ostrom's design principles have been used extensively in the study of CPR institutions such as fisheries (Cinti et al., 2014; Sarker et al., 2015), marine protected areas (Marinho Nobre et al., 2017), grassland (Schutz, 2010), irrigation (Sarker, 2005, Sarker & Itoh, 2001), agriculture (Termeer et al., 2013), and forestry (Fleischman et al., 2014). The studies use design principles for a range of purposes such as evaluating rules (Al Mamun & Brook, 2015), (re)evaluating CPR institutions (Barnett & Anderies, 2014; Collen et al., 2016), providing historical analytical frameworks of CPR institutions (Blomkvist & Larsson, 2013) under different frameworks of study assessment like compliance (Scholtens, 2016; Deepananda et al., 2016), cooperation (Werthmann et al., 2010, Bardhan, 2000), institution legitimacy (Ratner et al., 2013), collective action (Aubriot, 2002; Gautam & Shivakoti, 2005), and sustainability of the institutions (Dolfing & Snellen, 1999). When analysing institutions, some studies do explicitly not mention the use of design principles (Hoole, 2010; Mwangi & Wardell, 2012; Hoshino et al., 2016); other studies only have a partial effect on robust institutions (Saunders, 2014; Scholtens, 2016); in some studies, the principles are intertwined with other social, economic, and political factors (Koch et al., 2008; Sarker et al., 2015; German, 2018); or they are intertwined with other theories like social and ecological systems (Barnett & Anderies, 2014; Krupa et al., 2014; Oberlack et al., 2015; London et al., 2017). It may not be always in an explicit way, but Ostrom's design principles are closely linked to social and ecological aspects, as shown in the definition of the principles above. The importance of social and ecological aspects has gained much attention. It appears as a framework of a study as Social and Ecological Systems (SES). SES was first introduced by Folke and Berkes in 1998 in the book "Linking social and ecological

system" to improve resource management in complex adaptive systems (Colding & Barthel, 2019). As Ostrom's design principles, the SES framework is derived from local resource management systems. However, SES lack a common analytical framework (Colding & Barthel, 2019). Meanwhile, even though Ostrom's design principles may be incomplete, it provides an analytical framework that is robust enough to test empirical studies (Cox et al., 2010).

3.2. Transferability to Contractual Networks in "Hotbeds"

Governing principles for contractual networks in "hotbeds" have not yet been identified. This paper fills this gap by looking into the possibility of building on Ostrom's steering principles to form effective steering principles for contractual networks in "hotbeds." For this application to be successful, the prerequisites of contractual networks in "hotbeds" and the empirical situation or problems underlying Ostrom's works and the solutions they aim to achieve need to be comparable.

Ostrom designed her principles of self-regulation in response to Hardin's claim for the commons dilemma that requires external authorities to impose rules and regulations (Ostrom, 1999b). Network contracts likewise require a governance framework to work effectively toward a predefined end. Many, including Hardin, linked such governance frameworks to a plea for more coercive policy instruments (Næss, 2004). Regulatory theory, however, has illustrated that in many ways such top-down regulation is not effective, in particular where public institutions are weak (Black, 2002), which is also the case for "hotbeds". State-centred governance arrangements are often not the most effective option for regulation in political "hotbeds" (Haryanto & Purnhagen, 2019). Contractual arrangements, such as certification or private standards, can replace such state-centred governance arrangements (Degnet et al., 2020, Purnhagen, 2015). Ostrom's principles are also designed for arrangements where state-centred regulation is not the most effective option, and an alternative bottom-up solution may be a better fit.

Bottom-up collective action is in many ways the preferable governance mode in "hotbeds" (Haryanto & Purnhagen, 2019). Ostrom's design principles address such collective action in a variety of forms, from non-cooperative to cooperative behaviour (Ostrom, 1990). They provide valuable nuanced insights into facilitating conditions of effective collective action such as user group size, location and nature of the resource, relative homogeneity and interdependence among group members, past experiences with cooperation, external aid (Agrawal, 2001a), and other social capital like the relevance of local knowledge, leadership, culture, and history of past experience (London et al., 2017). Taken to the operational level, insights into the interaction between users and resources, and users and rule makers have been identified as other key factors for robust institutions (Barnett & Anderies, 2014). There are also valuable observations such as recognizing that the building up of robust institutions takes time (Termeer et al., 2013), resources (Cox et al., 2010; Collen et al., 2016), and underlying facilitating processes (German, 2018). These insights may also form a basic assessment of the situation in "hotbeds" that are characterized by a high level of poverty, insecure land tenure or landlessness, unstable and/or undemocratic political systems, and histories of state-sponsored repression.

We will illustrate the possible transfer of Ostrom's design principles as a steering governance principle to the situation of hotbeds with similarities of conditions and solutions between Ostrom's principles and the hotbeds as shown in the Table 2 and Table 3 below.

Table 2. Situation in Hotbeds

	Condition	Solution
1	High level of poverty. The question on who benefits from such resources remains central to the natural resources arrangement	Social process and justice: participation, self-representation, self-determination.*
2	Insecure land tenure and landlessness, posing significant barriers to participatory and collaborative approach	Power play at a higher level to build a constructive political action for tenurial security.*
3	Unstable and/or undemocratic political systems.	Legitimate processes through social control that build on strong agreements, fair enforcement, strong organizational and institutional arrangements, and constructive dialogue. Establish rules for decision making, accountability, enforcement, and participation. Constant reflection and experimentation. Organizational and social learning.*
4	Histories of state-sponsored repression	State and community take joint part in the creation and structure of institutions. Engaging communities in the commons governance, and policies and legislative reform to get communities sufficient control over resources through tenure form.**

*Adopted from (Brechin et al., 2002), beyond the square wheels: Toward a more comprehensive understanding of biodiversity conservation as social and political process

**Adopted from (Agrawal, 2001b) state formation in community spaces? Decentralization of control over forests in the Kumaon Himalaya, India

Table 3. Situations looked into by Ostrom***

	Condition	Solution
1	The problem of excludability and extractability/free rider issue	Boundaries that are locally crafted and agreed upon
2	Inequality and unfairness of cost and gained benefit will likely create an abiding rules attitude. Need an incentive mechanism to cooperate with such rules-in-use	Rules-in-use allocates benefits proportional to the required inputs
3	Outside users that live far away do not know the changes and will likely be slow and less flexible to adapt to changes. As the environment changes over time, it is essential to create such rules that can adapt more quickly and efficiently	Collective choice or participatory arrangements. Most individuals that are affected by rules are authorized to participate in making and modifying rules
4	Reliance on levels of trust and reciprocity alone among users may not be enough to reduce the concern that others will cheat and take advantage of others. No one likes being a loser.	Monitoring each other in an accountable way

	Condition	Solution
	Rules must be enforced in such a manner to create confidence in the system and produce more robust reciprocity	
5	Everyone can make an error or can face difficult problems leading them to break the rules. However, letting infractions pass unnoticed could generate a downward cascade of cooperation, especially in a community that relies on conditional cooperation and has no capacity to sanction. Others will be likely to follow in breaking the rules.	Graduated sanction. A person who breaks the rules will be notified (start with a low sanction) but others will notice the infraction. This situation will extend trust to the system
6	Some users may interpret rules differently than others. This may raise misunderstanding and create conflict.	Simple local rules that are understood by users and local mechanisms to air conflict immediately and provide resolutions that are known in the community
7	Unanimity imposes high transaction costs. There would likely always be a participant who is unsatisfied with the local rules and try to change and go to external authorities to threaten the local system. The presumption that only external government officials can make authoritative rules will hamper the sustainability of local systems	At least minimal recognition of the right to organize local systems by a national or local government
8	Most CPR are managed as part of a larger system that influences and is influenced by wider social, economic, and political circumstances. There is most likely always a level of interdependency among systems	Such systems are organized in multiple layers of nested enterprises, and a larger system exists to govern the interdependencies of smaller systems.

***Adopted from (Ostrom, 1990; Ostrom, 1999a; Ostrom, 2005a)

Conditions on hotbeds lead to solutions such as: securing land tenurial, participation, enforcement, accountability, adaptation, and including power play at a higher level that mainly relies on social processes. Somehow, at least for the moment, we can see the possible transferability into Ostrom's conditions and solutions. We will further assess the early application of such design principles to govern contractual network in hotbed cases.

3.3. Principles

In this section, we apply each principle to a contractual network situation in "hotbeds" to develop understanding.

3.3.1 Boundaries

The first Ostrom's principle aims to address free riding (Ostrom, 2005b; Ostrom, 2009). The ability to exclude non-appropriators through agreed eligibility rules (Deepananda et al., 2016; German, 2018) is an essential first step toward organizing collective action (Ostrom, 2009; Shimada, 2014). According to Ostrom, such boundaries do not have to figure in well-developed rules and/or agreements but could display in

simple forms like symbolic boundaries based on rituals and beliefs (Ostrom, 2005b). However, for the institution to be robust, it needs to have defined and well understood boundaries (Ostrom, 2005b). This informality indicates the existence of contractual networks. The existence of contractual networks, due to their ability to adapt and be completed by informal means, is often associated with such informality (Cafaggi, 2011).

Stakeholders cooperate to define the allocated resources and the appropriators, thus knowing who is the appropriator and non-appropriator, including their eligible rights and duties in order to maximize the benefit of cooperation (Ostrom, 2005b; Ostrom, 2009; Cox et al., 2010; Oberlack et al., 2015). This cooperative feature is similar to the input and output of contractual networks that requires forms of risk sharing and everyone's benefit depends on each other's performance (Cafaggi, 2011). If networks arise from input of resources such as information, or relationship among people, these inputs need to complement each other. If networks shall arise from outputs, it is necessary that the results of these networks are indivisible (Cafaggi, 2011). As a product of a cooperative feature, intrinsically, boundaries enable stakeholders to reinforce their rights (against non-appropriators) as well as directing monitoring duties of each stakeholder toward the system (situation) and behaviour (action) of others (Marinho Nobre et al., 2017). In some cases, the appropriator does not have to be the property owner. Decisive factors are such that go beyond rights associated with property ownership. Such facets include skills, capacity, or the ability to participate in including purchasing licenses and leasing the property (Özerol,, 2013; Krupa et al., 2014; Al Mamun & Brook, 2015; Scholtens, 2016).

In a common property regime when membership is hard to define due to mobility and diversity of the members, relying on boundaries alone is not enough. Nevertheless, congruence between cost and benefit could offer solutions to this situation. It means membership issues can be solved by distributing benefits not to the entire community but to the contributors, the one who bear the cost of managing the forest including involvement in cooperative labour. A necessary change to adapt to newcomers and mobile membership as shown in Iriai forest management in Japan (Shimada, 2014). Moreover, in most "hotbeds", enforcement of property rights is the problem. Who has the rights and the means to enforce is often contested by different stakeholders whether within the community, the community and outsiders, or the community and the state. Participatory mechanisms, such as consultation and engagement of local community, could help to overcome this problem (Degnet et al., 2020).

3.3.2 Congruence

The principle of congruence relates to the acceptance and legitimacy of rules-in-use by the community. The congruence principle is divided into two types: first, in relation to benefits distribution, which is consistent and proportionally equivalent to the related cost to implement such rules (Ostrom, 2005b; Ostrom, 2009), and the other one is "appropriation and provision rules are [in] congruence with local social and environmental conditions" (Cox et al., 2010 p.15). This means that risk is also shared among members (Araral, 2013). Related to contracts, risk and profit allocation is one of the features of contractual network emergence (Cafaggi, 2011).

Since every common system may differ in its ecological and social characteristics, it is essential that the rules-in-use conform to the local condition and their social mechanisms by which mutual consent lives within the systems (Ostrom, 2005b; Cox et al., 2010) as shown in a case of community-based coastal resource management in Kei island, Indonesia (Hoshino et al., 2016). The rules that are not developed based on

social and biophysical systems are under high risk of being violated (Al Mamun & Brook, 2015). Conformance to local conditions helps organize an arena for a trusting relationship among stakeholders (Ostrom, 2005b). For instance, in a case of an undemocratic arena, such as providing safe water in Uganda, the rules are set top-down and do not fit the local context, which contributes to the weakness of such an institution (Naiga et al., 2015). While each of these examples need to be seen and evaluated in their regional context, they all share the features which we describe as "hotbeds" and "contractual networks" in this paper. For this feature it seems as if the congruence principle, despite the regional differences, has the potential to provide a promising tool to steer contractual networks in a hotbed situation.

3.3.3 Collective choice or participatory arrangements

Collective choice arrangements reflect the ability of the affected stakeholders to tailor and modify rules that fit to local circumstances (Ostrom, 2005b). The idea departs from the importance of the best "know how" which relates to the affected stakeholders' knowledge, and their flexibility to modify rules (Cox et al., 2010). The essential features of this principle relate to the stakeholders' degree of engagement to resources (Oberlack et al., 2015), to the rules-in-use, and to participatory processes themselves (Ostrom, 2005b). In a larger system, the wider the representation of stakeholders, the better chance to secure cooperation and compliance (Ostrom, 2005b). Participation and representation could strengthen the stakeholders' network as well as information flows (Mwangi & Wardell, 2012). Rule makers and rule followers that agree on such rules show a positive effect toward a robust institution (Al Mamun & Brook, 2015). Ensuring participatory process is most likely producing rules that conforms to local conditions (Ostrom, 1990). Empirical research shows that active local stakeholder involvement in institutional changes in decentralized forest management in Tanzania lead to local level accountability, thus successful management of decentralized forest area (Babili et al., 2015). At the same time, contractual networks need a framework to develop means and tools to induce and sustain cooperation. Participation in such open ended relationship is important (Gómez & Cafaggi, 2011).

3.3.4 Monitoring

The idea behind the monitoring principle is that rules must be enforced (Ostrom, 2005b). Monitoring principles come at two different objects of interest, which are monitoring the action (behaviour of stakeholders), and monitoring the situation (the resources) (Cox et al., 2010). The importance of having equal attention on both monitoring activities is articulated in the *Sasi* system, which are local practices to manage sea-based resources in the Kei islands, Indonesia (Hoshino et al., 2016). Pervasive and routine monitoring (together with the threat of sanction) helps ensure compliance (Trawick, 2001) such as in artisanal fisheries in Argentina where informal monitoring and sharing information helps such fisheries to survive (London et al., 2017).

Monitoring that is accountable enables the system to build trust and to adapt to changes (rules and action-situation), so that cooperation may be well sustained (Ostrom, 2005b; Cox et al., 2010). It also means monitoring may not perform well and may create adverse effects when they are not accountable or when monitoring can't adapt to conditions (Cox et al., 2010). Monitoring is also about motivational engagement. Stakeholders that develop self-contingent awareness will be motivated to do monitoring (Ostrom, 2005b). This norm of active and routine monitoring sounds

compatible with contractual network performance where "unlimited liability is the rule in the form of both individual and joint liability" (Cafaggi, 2011 p. 11). Monitoring bridges agreed-upon rules and (graduated) sanction and helps to ensure compliance (Babili et al., 2015).

3.3.5 Graduated sanction

Graduated sanction lies in the premise of strengthening cohesion while giving punishment (Ostrom, 2005b; Cox et al., 2010). The implementation of gradually progressive sanction depends on social capital and their agreed-upon rules (Cox et al., 2010). The sanction comes gradually, potentially with a notification that eventually could lead to ostracism (Trawick, 2001) or being punished to some degree (Oberlack et al., 2015). Since "quasi-voluntary" is the value of the self-organized institution, the essential feature of the graduated sanction in such an institution is the capacity and ability to sanction (Ostrom, 2005b). The inability to sanction could have an adverse effect like creating conflict (Hoshino et al., 2016). Meanwhile, graduated sanctions could be strengthened by higher authority jurisdiction to enforce such rules (Chaudhary et al., 2015) as shown in the beach seine fisheries in Sri Lanka (Deepananda et al., 2016). Monitoring and sanctioning could have reciprocal and mutual effects on each other in improving the implementation of such rules-in-use (Hoshino et al., 2016), hence may work toward the performance of contractual networks.

3.3.6 Conflict resolution mechanism

Conflict resolution mechanisms relate to Ostrom's principle on graduated sanctions to solve the conflict (Ostrom, 2005b). It helps to build a more reliable system, thus increasing stakeholder confidence toward the systems (Ostrom, 2005b). The graduated sanction feature will only be able to work in institutions when the ability to enforce such rules is ensured (Ostrom, 1990). Strong enforcement will only be achieved when functioning monitoring is applied (Hoshino et al., 2016). In this regard, Ostrom's design principles provide an action-situation feature of participation to make rules that are enforceable in such accountable manners using fair graduated sanction with legitimate monitoring systems. In some cases, local informal enforcement systems alone may not be enough, and one may need external support for enforcement (Cinti et al., 2014). Following the logic of those action-situations, the hotbed area may need to address situations where the state's rule-making is dominant and the system is pretty much undemocratic. Furthermore, it may provide room for a hybrid approach, which combines top-down or state arrangements and local design principles based on the institution, (Collen et al., 2016; Deepananda et al., 2016) as long as the state can enhance user autonomy and local self-governance (Sarker et al., 2015) (Blomkvist & Larsson, 2013). This situation defines Ostrom's nested principles which link to higher authority.

3.3.7 Recognition of local rights to organized

This principle sees self-organized institution in a larger system. Hence, the ability of such self-governance arrangement to operate depends on the minimal recognition of the local rights to organize, or at least the states do not challenge it (Ostrom, 2005b; Cox et al., 2010). It is also related to giving legitimacy to implement their own crafted rules (Ostrom, 2005b). In an empirical study of local rules evaluation, it shows that incongruence between local rules (local practices) and state rules (formal law) leads to poor compliance (Al Mamun & Brook, 2015). On the other hand, combination of local

rules and state rules may lead to better governance (Al Mamun & Brook, 2015). However, the ability to self-organize depends on reliable and widely known information of the system among the involved stakeholders, as illustrated by Ostrom (Ostrom, 2005b). This situation reflects the required robustness feature of contractual network governance in such hotbeds where the network is able to self-organize their institution without being challenged by higher authorities.

3.3.8 Nested enterprises

Nested enterprises comprise two levels of integrations, which are horizontal and vertical (Cox et al., 2010). Horizontal integration refers to integration between the user groups, while vertical integration is integration between user groups and a higher jurisdiction (Cox et al., 2010). Cross-scale integration between community groups, the private sector, donor organizations, NGOs, and the state is illustrated in an empirical case study of conservation and ecotourism in Namibia where groups of stakeholders work together to achieve common objectives (Hoole, 2010). Social capital (including norms, network of trust, and rules) help to foster this cross-scale integration (Brondizio et al., 2009). The cross scale integration between user groups are organized or represented at such bridging platforms (Naiga et al., 2015). Hence, such bridging platforms for cross scale integration could be used as collaborative learning process arenas (Ratner et al., 2013).

The case of external impacts on traditional commons arrangement in the *Iriai* forest in Kyoto shows that contractual networks that are self-organized within a larger system may be sustainable under external influences (i.e. migration and price competition) due to their ability to adapt to changes as well as that the self-organized institution is recognized within the larger system (Shimada, 2014). A study on deforestation in hotbed areas of Indonesia emphasizes the need to pay more attention to external dynamics (e.g. market, state, NGO, international intervention) and their influence on such governance, while continuing to examine common pool resource theory (Fleischman et al., 2014).

4. RESULT: DESIGN PRINCIPLES IN CONTRACTUAL NETWORKS IN "HOTBEDS" IN WEST PAPUA

In this section, we exemplify the usefulness of the design principal application through a case study of hotbeds in West Papua. In these examples, we will rely on the insights the authors gained through research visits to West Papua from November 2018 – June 2019 with the visits divided between three different cases. The research sites are shown in a map below (Figure 1).

4.1. Description of West Papua situation

Indonesia has implemented a centralization – decentralization – recentralization policy in managing natural resources that creates conflicting interests and some opportunistic behaviour (Fatem et al., 2018). In the meantime, Indonesia has recognized the community's tenurial land (Larson, 2016). However, land tenure is regulated by complex arrangements of traditional, formal, and informal approaches and has resulted in tenurial insecurity and ambiguity over ownership and rights (Riggs et al., 2016). Indonesia is the most challenging country for tenurial insecurity (Sunderlin et al., 2014). Today's highly complex land tenure system in Indonesia is influenced by Dutch colonisation, trade, and migration that evolved into current forms of traditional, formal, and informal arrangements (Riggs et al., 2016).

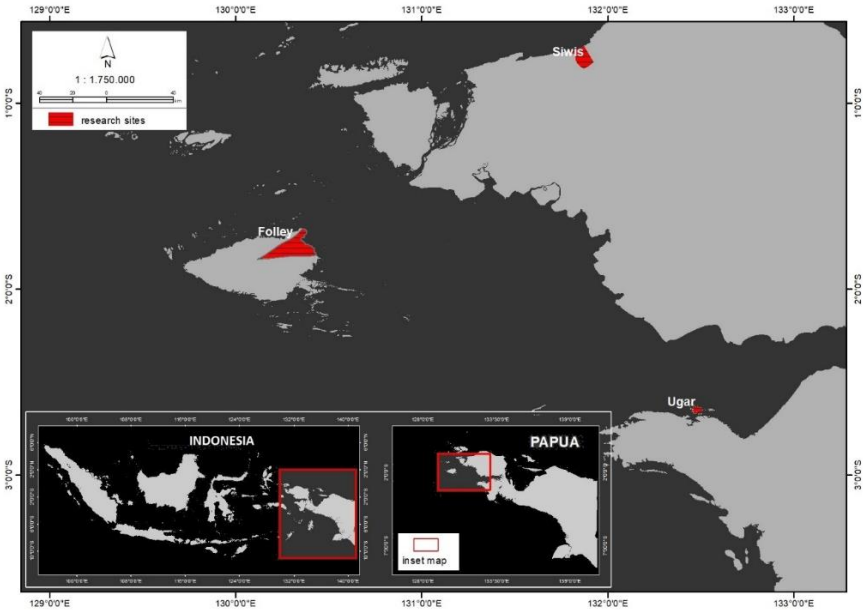

Figure 1. The research sites.
Source: Map of *Rupa Bumi Indonesia* (Indonesia's land), 2016

This situation is reflected in how West Papua traditionally managed resources based on traditional knowledge but still had tenurial insecurity. In recent years, the land of Papua has been the target of large scale plantation investments (Obidzinski et al., 2012). Some efforts have also been made by different levels of government to incorporate tenurial systems into their policy and approach of development (Fatem, 2019). Conflict and cooperation have also been recognized. Papua and West Papua are considered as the most violent yet the most resource rich regions of the country (Anderson, 2015). The conflict is not just part of military repression but also vigilantism act, clan and tribe clash, and other forms of horizontal conflict (Anderson, 2015; Sari, 2017). Different interests have created networks of stakeholders. Traditionally, Papuan people have a typology of customary leadership that defines community governance systems, including resource management (Mansoben, 1994; Reumi, 2018). Based on the author's observation, customary law sets rules for representation, election, and dispute resolution.

Community governance is organized in a hierarchical way, where the leader with a bunch of supporting individuals in the community rule the community. At the same time, the state has its own system of governance that influences community governance such as community hierarchical structure. Both the community and the state respect customary leaders. Sometimes, the customary leader also acts as a state's representative head of the village. This situation may create a conflict of interest for the leader and may result in the absence of both systems in the community. Nowadays, the community follows customary law, which also influenced by religion. It means stakeholders that are related to religious institutions, like a priest for Christians and an Imam for Muslims, become more prominent than before. The arrangement of the tenurial system shows a complex network of involved stakeholders. This system is

closely related to social, cultural, and economic factors like kinship, leadership typology, livelihood sources, rites, and spiritual beliefs. In general, tenurial ownership and rights are categorized into communal and individual approaches. This division extends from tribes and clans to the family and individual level.

The landlessness or insecurity of tenure is caused by vertical disputes (with the government) and/or horizontal disputes (within or inter-community). Vertical disputes happen when the interest over resources between government and community are not aligned each other, such as in the area of the *Siwis* village of *Klaso* valley in *Sorong*, where the government uses the forest as a production forest that could be converted to agricultural purposes while the community wants to protect the forest based on their cultural and historical ties. Horizontal disputes may happen between communities such as in the village of *Folley* in *Raja Ampat* where fishers from outside the village conducted illegal fisheries catch. The governance of resources is also influenced by other outside stakeholders like the business and NGOs (local and international). The interaction of the community and the outside stakeholders creates a network of relationships either in terms of conflict or cooperation. These complex social interactions that involve different stakeholders and diverse interests relates to the type of situation of contractual networks in such hotbed areas for our research.

4.2. "Fit" between Ostrom-type situations and West Papua situations

Natural resources in West Papua can be described as intact, vast, and difficult to access. These characteristics make governing the resources in a sustainable, efficient, and equitable manner challenging. The different use of regulations creates conflicting interests due to different natural resources valuation and management approaches between community and outsiders or among community members. For instance, conflict extends to allowed activities and the timing and location to do such activities. One can still get the benefit from resources without contributing to maintain the resources, as well as extraction by an individual reduces the availability to others. As such, illegal activities occur. It is not an easy task to address free rider issues. In *Siwis* village of *Klaso*, the outsiders cut the wood without further obligation to maintain or improve the condition of the forest. In *Folley* and *Ugar* village, we can still find illegal fishers in forbidden places and times. This situation relates to Ostrom's situation on common pool resources where a resource is characterized by its difficulty of exclusion and extractability.

It is common to find villages in West Papua that are located in the vicinity of natural resources either in forest, on the island, or on the beach. Traditionally, the local livelihood depends on the resources around them. Nowadays, livelihood sources are getting more diverse and do not merely depend on the natural resources. However, the local communities' natural resource dependency is more than a livelihood source. Natural resources are part of their identity, their culture, and their beliefs. In that respect, local communities are still the main users of the resources. In a current situation, the state is the legitimate authority over resources based on the constitution. The community has their own customary rules, and the business or outsiders may be granted a legitimate permit by the state to the resources. Often, we find the outsider stakeholders (i.e., non-government organizations) are influencing the dynamics of the rule and decision-making processes. It is possible that every stakeholder makes its own rules and makes it legitimate based on its own standard or that every stakeholder is affecting other rule-making either through coercion or cooperation.

Conflict and cooperation depend on the approach chosen at the time and it may change over time. This situation fits the Ostrom situation of collective choice arrangements. The question remains as to which degree the major users of the resources is involved so the rules can adapt to the changes in a more efficient and effective way. Based on early observation, we can find different levels of local involvement and a different degree of self-organized governance. In *Ugar* village, communities govern their coastal resources based mainly on traditional knowledge and beliefs. The people in the community participate in the decision-making process while the decision is solely in the hand of the customary leader. In *Folley* village, the coastal resources governance is influenced by NGOs, religions, and scientific values. The participatory arena for decision-making process is through family representatives. The decision is part of negotiation and must be agreed on by customary leaders, the priest, and the community leader. In *Siwis* village of *Klaso-Sorong*, the governance of the forest by the community exists based on customary rules but is challenged by outsiders and higher authorities.

Free riders and tenurial insecurity have somehow influenced the degradation of the resources. Outsiders influence the dynamic of social, political, and economic circumstances, such as livelihood sources, and the level of dependency to the resources. Based on early interviews, in all three cases (*Siwis* village of *Klaso, Folley*, and *Ugar*) resources have been degraded. However, problems caused by free riders and tenurial insecurity have been significantly improved as communities have been able to access more reliable information about the resources. This also aids planning around the availability of the resources for community's needs, and the setting of boundaries for resources through an internally agreed upon method – usually a particular man-made or natural sign – has become the norm. Based on early interviews in *Folley* village, the current natural resources governance (named: *Sasi*) has improved the abundance of the sea cucumber. In *Ugar* village, the community always know where and when to catch fish individually and when to hold a communal harvest based on their traditional calculation of resource availability. In *Siwis* village of *Klaso*, they apply boundaries that are known by tribe, clan, family, and the individual and each knows the general condition of the forest, including the no-go areas or sacred places. This situation of resource attributes fit in Ostrom's situation as described for self-governance arrangements.

The dependencies on resources have somehow changed over time. However, community dependencies in West Papua are not just about livelihood variables but also about identity, culture, and beliefs. Therefore, natural resources are still important for the local people. We can find a common understanding about resource conditions in the community, including their borders and the predicted availability. This means that every local user with different livelihood sources, different economic conditions, and political assets values the resources in a similar way. The degradation of resources, the loss of resources, and the current pattern of resource use affects every local user similarly. Users have also shown some level of trust to each other. At least this is indicated by the long-lived existence of local customary institutions and the individuals related to the institutions that are still respected. Reciprocity happens in such a way to make sure resources are maintained. The situation of users' attributes fit in Ostrom's situation as described for such self-governance arrangements.

4.3. Application of Ostrom's design principles to West Papua

All of the above situations show the early compatibility of Ostrom's situation to the West Papua situation. We will now elaborate more on the application of Ostrom's design principles to these case studies.

4.3.1 Boundaries

In practice, the boundary principle is often expressed in informal ways in contractual networks that govern "hotbeds". Take the example of *Siwis* village of *Klaso* in *Sorong*, West Papua, Indonesia.[1] Several groups of stakeholders in the community have agreed on their own forest boundaries for years, which is recognized by local municipalities. The border of their boundaries follows landscape features like rivers, creeks, rocks, etc. They create their boundary based on their own ecological and physical knowledge about the area with a process that is led by powerful stakeholder groups. The boundary defines property rights of each family and determines different uses of the area, such as daily livelihoods like farming areas and conservation areas through forbidden or sacred place. With agreed upon and clear boundaries among each family, the community cooperates to maintain the resources, excluding non-appropriators as well as monitoring each other's behaviour. Such agreed upon and recognized boundaries is challenged by corporations with an interest in logging and by weak enforcement of these property rights by the government. Such behaviour of non-community members creates new boundaries based on their own knowledge and judgement, without prior discussion nor consultation with the community. As a result, the new boundaries and the corporation's interest is not respected by the community, hence no cooperation is achieved. The process of declining the new boundary spans from negotiation to coercion. This example shows that boundaries that are set by the community could define such strong cooperation, including excluding outsiders.

4.3.2 Congruence

Take the example of the village of *Folley* in *Misool* island, Raja Ampat, West Papua, Indonesia. [2] Stakeholders developed a rules-in-use system to manage the coastal resources in a sustainable way. The rules-in-use fit the local situation and conditions e.g., boundaries are set based on the families' property boundary and the capacity to enforce such boundaries, harvesting appropriation provisions are based on biophysical conditions, and the agreement for rules-in-use is based on a social system of the community which includes beliefs and traditions. As a response, the rules-in-use are easily understood and done by the stakeholders and such collective action is achievable. The result of compliance toward the rules is considered high.

4.3.3 Collective choice or participatory arrangements

Returning to the village of *Folley, Misool* island, Raja Ampat, West Papua, Indonesia.[3] Here, stakeholders established an arena for collective choice arrangement or participatory process. The participatory process involves representatives from each family and some powerful actors in the community such as the elders, the priest, and

[1] This case is based on a visit of Taufik Haryanto and Kai Purnhagen to the area on *Siwis* village of *Klaso* in *Sorong*, West Papua and open interviews consulted there.

[2] This case is based on a visit of Taufik Haryanto to the area on *Folley, Misool* island in Raja Ampat – West Papua and open interviews consulted there.

[3] This case is based on a visit of Taufik Haryanto to the area on *Folley, Misool* Island in Raja Ampat – West Papua and open interviews consulted there.

the village government representative. Participatory process is a relatively simple process and could be done in an informal way. Such models of participatory process enable the system to adapt and to change the rules quicker when necessary. The agreed-upon decision from this participatory process is announced in a trustable and legitimate institution, which is generally the church or through daily contacts. As a response, the rules-in-use is crafted in an easier way and the consensus decision is easily spread. As a result, community cohesion toward such systems is improved and the system get the support from the community in a wider scope, not just from the property owners. It helps to build such robust institutions.

4.3.4 Monitoring

In the village of *Ugar* in *Fakfak*, West Papua, Indonesia they have their own monitoring system.[4] This system is mainly based on their own customs and beliefs. Members of the village monitor each other's and outsiders' behaviour. Monitoring is also done on the resources. Monitoring activity is relatively easy because the area of monitoring is part of their daily livelihood activities, which is their fishing ground in a coastal area around the village. Monitoring is somewhat accountable and helps the leader to make needed enforcements. Notice that the reported rule violations and its sanctions are not always spoken openly and could spread like a rumor-based social sanction. As a response to this monitoring system, enforcement is applied based on the customs and beliefs. The sanctions are applied gradually that are related to the belief, from minor sanctions to such as being cursed until death. This monitoring creates a level of compliance which helps the system be sustained for decades.

4.3.5 Graduated sanction

In *Siwis* village of *Klaso* in *Sorong*, West Papua, Indonesia[5] sanctions are applied gradually based on the level and repetitiveness of the violation. The implementation of graduated sanction is based on local customs and beliefs. The sanctions take the form of scolding (the lightest) to expelling out of the community (the hardest). The family and the community work together to implement and monitor the sanction. As a response, the community takes extra considerations if they want to break the rules-in-use. In some ways, graduated sanctions that are based on local customs and beliefs help with community cohesion. One may argue which one comes first, the sanction or the cohesion. However, this graduated sanction helps to build compliance toward the rules. At the same time, cohesion and sanctioning take part in challenging imposed outsiders' rules.

4.3.6 Conflict resolution mechanisms

In *Folley, Misool* island, Raja Ampat, West Papua - Indonesia[6] conflict resolution mechanisms involve several elements of the community such as the community elders, the religious leader, and the village government leader. The mechanism comprises formal and informal approaches. The formal approach means legal formal rules, the informal approach means local consensus. The use of such approaches depends on the

[4] This case is based on a visit of Taufik Haryanto to the area on *Ugar* village in *Fakfak* – West Papua and open interviews consulted there.

[5] This case is based on a visit of Taufik Haryanto and Kai Purnhagen to the area on *Siwis* village of *Klaso* in *Sorong* – West Papua and open interviews consulted there.

[6] This case is based on a visit of Taufik Haryanto to the area on *Folley, Misool* island in Raja Ampat – West Papua and open interviews consulted there.

scale of the conflict, for instance conflict with neighbouring villages could take a legal formal approach, while conflict among community members mostly takes the informal approach. Such conflict resolution mechanisms are considered as a low-cost mechanism, because the conflict can be solved immediately, and the rules can adapt to changes easily. As a response, community members feel more confident in the system since they somehow understand what to do when conflict arises. It helps to build such robust collective action systems.

4.3.7 Recognition of local rights to organize

Take the example of *Siwis* village of *Klaso*, in *Sorong*, West Papua – Indonesia[7] where the local rights to organize their resources is not recognized and at the same time are challenged by the higher authority. The higher authority sets their own management plan on the basis of legal jurisdiction, while the community has their own system to manage the land and resources within based on their custom. The lack of local rights recognition creates such mistrust. As a response, any system that is built by only the community or only by the higher authority is conflicting and not getting support from the other. This situation creates endogenous conflict potential that could come to surface anytime, once the trigger is there. As a result, it is hard to build a robust collective action system for the management of the landscape. The example of the village of *Ugar* in *Fakfak*, West Papua – Indonesia shows more or less the same case e.g. the local rights to organize are not (fully) recognized. It means the higher authority respects the existence of local institutions to manage their resources but it is not on their legal jurisdiction system. At the same time, the local institutions and their rights are also not challenged by the higher authority. As a response, there is no such open conflict between the community and higher authority. As a result, the local institution system lasts for decades and the community could still make collective action for the resources around them. Recognizing and challenging the local institution by the higher authority has an impact on the robustness of the system.

4.3.8 Nested enterprises

Take the example of the village of *Folley* in *Misool* island of Raja Ampat, West Papua – Indonesia[8] where the local institution is part of the higher institution. The local institution is included in the sea zoning system of a higher institution (regional government zoning area). Therefore, the local institution and its activity is recognized by higher authority. This engagement by a higher authority helps to build a sense of security and ownership of the system. It not only helps to build such collective action in the community but also helps to challenge unwanted behaviour of both appropriators and non-appropriators.

5. CONCLUSION

This article looked into the existence of functioning frameworks to govern contractual networks in hotbed areas. Specifically, it considered two research questions: can Ostrom's design principles serve as steering principles for functioning contract governance frameworks? and, how can they be embedded into contractual

[7] This case is based on a visit of Taufik Haryanto and Kai Purnhagen to the area on *Siwis* village of *Klaso* in *Sorong* – West Papua and open interviews consulted there.

[8] This case is based on a visit of Taufik Haryanto to the area on *Folley*, *Misool* island in *Raja Ampat* – West Papua and open interviews consulted there.

networks?

With respect to the first question, we found that contractual networks may be used as a governance tool for sustainable natural resources management in hotbed areas. However, it requires a governance framework to steer the web of relationships of collective action to achieve such common objectives. The premise lies in the need of securing cooperation in such complex social relationship and hotbed areas where networked contracts take place. Our analysis shows that the willingness to cooperate determines the success of collective action. Social mechanisms, including trust, are seen as more essential factors rather than formal (state-centred) regulations to enable cooperation and thus collective action. Therefore, it is important to focus on enabling social mechanism factors for collective action. The enabling factors are influenced by ever-changing stakeholder properties such as participation, access, social and economic incentive, norms, culture, locally organized rules-in-use, legitimation, and equitability. The changes are influenced by external and internal circumstances.

In terms of the second question on embeddedness, the comparison analysis of action-situation and solution renders the following results:

- Ostrom's design principles address a stipulated argument of command and control governance and propose a self-organized regulation as a solution. This action-situation and solution may fit with a contract governance framework that works more effectively with less government interference in such hotbeds.
- Ostrom's design principles facilitate self-organized institutions through social mechanisms to build collective action with influencing factors of social capital and external influences to some extent. The analytical action-situation and solution circumstances have such similar action-situations toward the need of contractual network governance in hotbeds where bottom-up collective action has been identified as the more preferable governance.

In action-situation and solution comparison, we extrapolated each of Ostrom's design principles to observable situations in contractual network governance in hotbeds. It shows that boundary principles that works in informal arrangements could be a strong tool to address the free rider issue. Boundaries and cooperation also influence each other in determining collective action. This situation reflects the situation and needed solutions of hotbeds, which has a feature of insecurity of tenurial rights or landlessness. Congruence principles help to define the acceptance and legitimacy of such rules-in-use. This relates to the logic of sharing risks and benefits, and local conformance to building compliance toward such rules-in-use. The exemplification of this congruence principle to contracts in such hotbeds shows local conformance as a strong determination for compliance, while cost-benefit congruence does not show obvious effects toward compliance. This may relate to community characteristics or to the cost benefit analysis that is wider than economic incentives.

Collective choice or the participatory arrangements principle helps to build a robust institution that enable stakeholders' cohesion toward the system. This principle may well fit to steer such contractual governance in hotbeds which feature undemocratic systems. Monitoring and graduated sanction principles address rule enforcement. In such contractual networks where enforcement is an issue, this principle may be a steering principle. However, the question of accountability remains, as to what extent and in which context accountability matters. It may relate to stakeholder or communities' characteristics. The importance of conflict resolution mechanism principles lies in the flexibility to change and modify rules-in-use. It gives

room for adaptation. This principle could be used to steer such contractual governance in hotbeds where the state approach (formal regulation) may help to build compliance to some extent. Local rights recognition and nested principles relate to the higher authority influence on such cooperation. Both principles put these systems as part of larger cross-scale systems. The observable cases example shows that local rights recognition, as well as them not being challenged, is important to define the successful cooperation. These two principles could be used as steering principles for contractual network governance in such hotbeds where higher authority will always be present to some extent.

Some principles show a more obvious interaction with each other in defining collective action, such as in monitoring and graduated sanctions where the work of monitoring defines the sanction and vice versa. Boundary and local rights recognition as well as nested enterprises show the mutual inter-relationship. The integral existence of conflict resolution mechanisms and graduated sanctions may well be defined to each other. Ostrom's design principles show system value in such governance frameworks that relate to how such contractual network governance works for achieving such collective action in such hotbeds. Therefore, this paper predicts Ostrom's design principles could be used as such steering principles for contractual relationships in hotbeds. Further, we argue that Ostrom's design principles could be embedded in such contractual network governance tools with different behavioural patterns, stakeholder characteristics, or context. It will also be interesting to analyse the relationship of each principle to govern such contracts. More empirical research is needed to solidify these theoretical arguments.

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