Transdisciplinary approach to natural resource governance research: a conceptual paper

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Abstract

Purpose – Natural resources in contemporary times are mostly managed by a collaborative governance approach which hinges on complex institutional designs (rules, norms and strategies). Many studies have been designed and carried out to assess collaborative governance, and the various institutional designs underpinning them. The purpose of this paper is to unpack the methodological gaps in natural resource governance research (with emphasis on co-management) and to conceptualise the appropriateness of Transdisciplinary (TD) research approach.

Design/methodology/approach – The paper adopts a critical stage review of relevant theoretical and empirical literature on natural resource governance. It discusses the complexities inherent in natural resource governance and juxtaposes these with the inherent weaknesses in methodologies employed by existing studies on the concept. The authors make a case for a TD research methodology that links scientists, practitioners and society in a joint problem design and solution process.

Findings – The authors register a "fuzziness" of the collaborative governance phenomenon but observe a methodological gap in existing studies on the concept. This paper discusses the complexities inherent. The paper describes TD as a "tailor-made approach" to solving complex societal issues and makes a case for its adoption in natural resource governance studies.

Research limitations/implications – This standalone paper is largely conceptual and not linked to any primary data; this notwithstanding, it synthesizes from both empirical and theoretical literature which would help shape future research endeavours in natural resource governance context.

Practical implications – With TD study oriented towards an epistemologically flexible approach, perspectives from different social and academic actors are integrated in this expanding field of research to address societal problems.

Originality/value – The paper provides a conceptual framework designating how actors interact in the TD research process as well as a "four-phase" approach in carrying out a TD research.

Keywords Transdisciplinary, Complexities, Co-management, Institutional assessment, Natural resource governance

Paper type Conceptual paper

1. Introduction

Protecting the environment and its resources has been a key goal championed by the global community which featured in the erstwhile millennium development goals and were also very prominent in the Rio+20 outcome document "Sustainable Development Goals" as well as in various classic and contemporary international ratifications. Whilst earlier thinking on natural resource management tended to focus a great deal on the role of national governments and appeared to view the existence of communities as being detrimental to

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management and conservation, there has been a paradigm shift towards one that regards communities as strategic partners in natural resource conservation and management. After assessing research outcomes of the 1990s, Agrawal and Gibson (1999) observe a "break from previous work on development which considered communities to hinder progressive social change" (p. 630). They noted that writings from the 1990s "champion the role of community in bringing about decentralisation, meaningful participation, cultural autonomy, and conservation" (p. 630). This "repentance" or turnaround is fundamentally attributed to a key narrative by Ostrom (1990) that local communities, when granted sufficient property rights over local forests, can self-organise and develop local-level institutions to regulate the sustainable use of natural resources. In a recent study Ojha (2014), however, maintains that community-based natural resource management should be linked with the work of other actors (collaboration or co-management) in order to strengthen capacities to counter the shortfalls associated with mutually exclusive approaches.

Generally speaking, all natural resources could be underpinned by co-management, however, those with supportive property or tenure rights provide suitable attributes that strengthen the basis and processes of collaboration (Borrini-Feyerabend *et al.*, 2004, p. 69). Collaboration for effective governance could be applicable to all natural resources but more pronounced in forests and wildlife resources, fisheries and coastal resources, grazing lands among others (Borrini-Feyerabend *et al.*, 2004, pp. 69-70). Even with regards to non-renewable resources such as oil and mineral deposits, although partnership arrangements used to be largely uncommon, there are emerging trends facilitating co-managements (see Mate, 2001; McCay and Acheson, 1987). For the purpose of this paper, natural resources as used here involve those that have clear property and tenure systems (e.g. forests and wildlife) with more or less manifest and latent (potential or plausible) stakeholders who have claims and entitlements to the resource.

The idea of collaboration in natural resources has become a pragmatic approach to solving natural resource management problems by partnership, owing to the difficulty for indigenous communities alone to effectively manage natural resources because of the complexities and heterogeneity of contemporary societies. On the other hand, there is a plethora of evidence to support arguments that centralised management of local resources is equally problematic (Carlsson and Berkes, 2005). Co-management of resources is not feasible without proper designs for the distribution of power, responsibility and relationship among actors. This makes the role of institutional arrangements highly distinctive in natural resources co-management processes and policies. The concept of social scale has been used to describe the different dimensions of institutional size, various actors and their representation, as well as power-sharing arrangements, whose dimensions range from individuals to networks of organisations, involving inter alia the rules, laws, policies and norms that govern the extent of resource-related rights and management responsibilities (Gibson *et al.*, 2000; Cumming *et al.*, 2006).

Although recent publications and policy documents on natural resource governance appear to place an emphasis on institutions or rules and their analyses (see Yeboah-Assiamah *et al.*, 2017; Fischer *et al.*, 2014; Petty *et al.*, 2015; Arts *et al.*, 2014), the methodological approaches do not really make for a more holistic analysis. Whilst most of these studies appear to assess the role of institutional design in natural resource governance, the approaches adopted do not enable them to adequately explain how these institutions have evolved or been shaped over time. For instance, Fischer *et al.* (2014) write, "our findings suggest that such insights into historical institutions are absolutely indispensable for the design of today's co-management arrangements […] research and applied conservation work need to understand historical relationships between the relevant actors to make contemporary resource governance sustainable" (p. 168). However, throughout that study the presence of community or other relevant actors is not readily evident in the analysis; such a study requires people or

community members to tell their stories in the form of narratives which would clearly bring out the socio-cultural and ecological factors that have shaped the institutional arrangements. Institutional arrangements, their relevance and challenges in natural resource governance have been addressed fragmentarily by scholars adopting somewhat mono-disciplinary perspectives, which may lead to conclusions that do not really unearth the underlying factors underpinning contemporary natural resource governance policies or institutions. In a study by Maciejewski *et al.* (2015) the authors themselves observe a major limitation by remarking that "while our analysis shows that socio-ecological elements inevitably interact across multiple scales to produce positive and negative outcomes, we do not investigate the mechanisms that produce cross-scale feedbacks and scale-mismatch" (p. 21).

Adequately assessing institutional dimensions, institutional evolution and implications for natural resource co-management requires a transdisciplinary and holistic study that engages with multiple stakeholders and community members in co-designing and co-producing knowledge on the institutional processes underpinning the particular resources. The main object of this paper is to provide a review of the contemporary literature on natural resource governance (co-management and institutional designs) with a view to conceptualising the appropriateness of transdisciplinary (TD) research approach. The paper conceptualises, through an illustrative framework, the key actors to be involved in such TD studies. The paper is underpinned by the following key research questions:

RQ1. To what extent do the prevailing approaches help link the researchers to the researched?

RQ2. To what extent do research outcomes really make known the voices of the researched?

RQ3. To what extent does a TD research outcome influence natural resource policies and their enforcement?

2. Conceptual overview

The essence of this review is to tease out the complexities associated with natural resource co-management as well as the complexity of the corresponding institutional underpinnings and multi-layer stakeholders. This section discusses the concept of co-management and its ramifications, as well as the stakeholder theory which underpins the study.

2.1 The concept of co-management

Coming to the realisation that natural resources management and conservation processes are multifaceted and involve different stakeholders, the traditional bureaucratic and state-centric approach is rapidly paving way for a more inclusive model that recognises and involves a network of actors who have a stake in the resource in question. This process has become known as inter alia "collaborative natural resource governance" or "co-management" (Yeboah-Assiamah *et al.*, 2016). The concept connotes an approach to solving environmental problems by bringing together a network of stakeholders who are drawn together in an arrangement that addresses issues of power and responsibility. This reflects a definition by Berkes *et al.* (1991) that describes co-management as "the sharing of power and responsibility between the government and local resource users" (p. 12). On their part, Borrini-Feyerabend *et al.* (2001) conceptualise co-management as "an arrangement whereby two or more social actors negotiate, define and guarantee amongst themselves a fair sharing of the management functions, entitlements and responsibilities for a given territory, area or set of natural resources" (p. 1). The operational phrase here is "fair sharing of the management functions, entitlements and responsibilities"; this should be the hallmark of co-management regimes and it should be viewed as a continuum and not static. Carlsson and Berkes (2005) maintain that

"the system should be understood as a process in which the parties and their relative influence, positions and activities are continuously re-adjusted" (p. 67). The foregoing argument also reflects the wise counsel by Garaway and Arthur (2004) that "there have been increasing calls for us to learn from our actions and from our mistakes, acknowledging that we can often learn as much, if not more, from why things did not work as we expected as from when they do" (p. 33). This makes the role of learning, adapting and readjustment absolutely critical to the success of co-management processes. In a subsequent publication Borrini-Feyerabend *et al.* (2004) define co-management as "a partnership by which two or more relevant social actors collectively negotiate, agree upon, guarantee and implement a fair share of management functions, benefits and responsibilities for a particular territory, area or set of natural resources" (p. 69). They explain co-management as involving a coalition of stakeholders drawn together to manage a particular resource, and such a relationship is maintained and sustained through sharing power and responsibility.

The co-management of natural resources is a pragmatic approach to address a complex phenomenon through an array of stakeholders. Muller (2010) thus highlights the point that "it is therefore not surprising that the 1990s were hailed as the "Age of the Network" characterised by modes of governance that link actors in the public, private, community and voluntary sectors" (p. 143). See Figure 1 for a network analysis of actors in natural resource co-management.

The framework above indicates that co-management efforts for effective natural resource governance need to be cross-sectorial and encompass the reasonable interests of stakeholders in managing the said resources. There is a relationship among all actors (iterative), hence the interaction is not unidirectional but intersectional. Each stakeholder interacts with the other so as to enable the effectiveness of the co-management process. The interplay of actors from diverse or heterogeneous backgrounds and interests (see Table I) would lead to proper problem identification and boundary analysis, which in turn makes for a holistic problem definition and consequent policy formulation that is shared and agreed upon to a greater extent. It is true that conflict may inevitably occur because of the diverse and mostly contradictory interests of stakeholders, but at the heart of the political process or any purposeful endeavour is conflict resolution and consensus building (Heywood, 2004). It is far better to confront the hurdles and address them head on than to ignore pressing issues and encounter implementation hiccups or Type (III) errors in the problem-solving process.

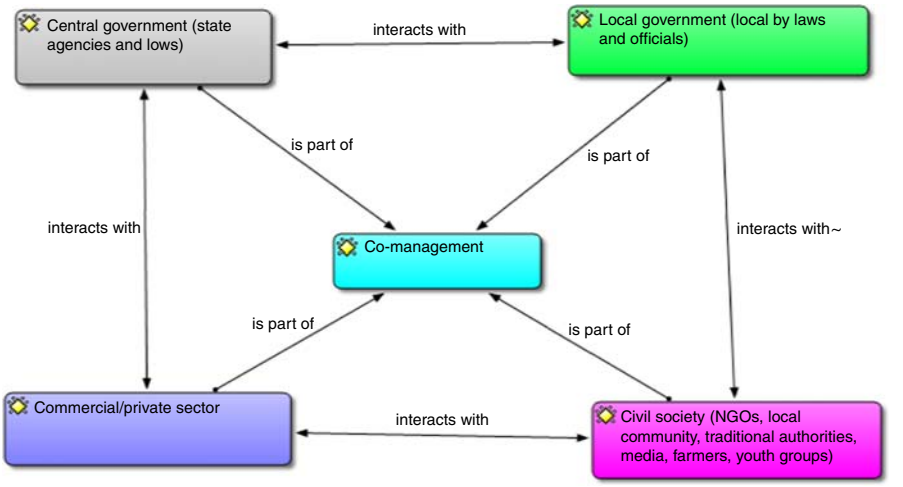


Figure 1.
A network analysis of natural resource co-management

Source: Modelled by authors using ATLAS.ti

Actors	Interests
Central government	Stated mandate over a given resource, sector or territory. Largely interested in productivity of the resources and their protection
Local government	District or municipal authorities who control natural resources as part of their governance or jurisdiction mandate. Mostly interested in managing jurisdiction conflict
Commercial/private sector	These are business and industry entities (local, national and international) who have economic interests in the resources, e.g. tourist operators
Non-governmental organisations	Local, national, international agencies interested in environment and/or development issues) whose domain encompass the resource and territory. Largely interested in representing and defending interests of local people
Local resource users and groups	Involves local and non-local, direct and indirect, organised and non-organised users who derive subsistence and economic benefit. Also includes a recognition of resource for cultural or religious purpose

Source: Adapted from Borrini-Feyerabend *et al.* (2004) (see Rathore, 1997; Triantafyllidis, 1996 for further reading)

Table I. Generalised interests of stakeholders in co-management

A Type (III) error occurs in the policy process when the right policy solutions or effective policies are formulated but for poorly identified problems. To avoid this error, it is imperative to take the time to embark on a broader consultation to involve wider interests in order to appreciate the real problem, its scope and boundaries (Dunn, 2004).

2.2 Theoretical framework

Wherever there are natural resources, different stakeholders will lay claim to aspects of those resources. People and groups have different attributes that attach them to a particular resource. For instance, three main primary stakeholders, with varying levels of influence, are identified by Duane (1997), as will be discussed in this section. The argument is that managing natural resources entails dealing with some complexities and higher stakes; therefore any research that seeks to understand the institutions or rules underpinning the management of particular resources needs to understand the point of view of the various stakeholders. It is only when one appreciates the complexities involved that one will understand the need to adopt complex a transdisciplinary analysis approach. This paper is therefore underpinned by stakeholder theory.

2.2.1 Stakeholder theory. A common theme that runs through the understanding of what constitutes a "stakeholder" is "influence" – the ability of stakeholders to influence the realisation of organisational goals. The level of influence of stakeholders is very important, which suggests that three dimensions – the organisation or entity in question, the particular goals to be realised, and the context – are critical in stakeholder analysis. After a cursory analysis of about 28 definitions of the concept of stakeholder, Mitchell *et al.* (1997) suggest three distinctive characteristics: power, legitimacy, and urgency.

Power involves the ability to influence the actions of others to do things to bring about a desired outcome. This "ability-to-do" notion is advanced by Salancik and Pfeffer (1974), who recognise a fundamental attribute of those with power as "the ability […] to bring about the desired outcomes they desire" (cited in Mitchell *et al.*, 1997, p. 865). Therefore, in natural resource governance, especially in rural areas, there are individuals and groups who are relatively powerful and have the ability to influence the outcomes of resource conservation or protection. It is imperative to identify various stakeholders irrespective of the strength of their power, however a context-dependent approach is much desirable.

The concept of legitimacy generally refers to the perception of the rightfulness of an action or entity which has influence on how people react or respond. In the words of

Suchman (1995), it is "a generalized perception or assumption that the actions of an entity are desirable, proper, or appropriate within some socially constructed systems of norms, values, beliefs and definitions" (p. 574). The notion of legitimacy is a subtle one, since it is more of a perception and socially constructed embedded in conventions, usages, practices, history and norms, it suggests that the particular context of any intervention is key in identifying stakeholders. For instance, in natural resource management in rural African communities, a network of stakeholders that does not include traditional chiefs will be more likely to face legitimacy deficits, which in turn means that policies which emanate from such studies are likely to face enforcement challenges.

The final attribute of stakeholders is urgency, which involves the sensitivity of the claims made by particular groups or individuals to the resource in question for which immediate attention might be required. This point is well explained by Jones (1991) as the extent to which stakeholder claims call for prompt attention. Jones further argues that this "call for attention" is mainly driven by two key indicators: "time-sensitivity", which refers to the degree to which managerial delay in responding to the claim or relationship is intolerable to the stakeholder; and "criticality", which measures the worth or relevance of the claim or relationship made by the stakeholder (cited in Mitchell *et al.*, 1997, p. 867).

In reality the dynamics of stakeholder engagement change over time; Freeman (2010) observes that it may change depending on the strategic issue at stake. Mitchell *et al.* (1997) argue that if a stakeholder possesses only one of the three attributes (power, legitimacy, or urgency), they are referred to as latent stakeholders and therefore possess minimal stakeholder salience. Stakeholders who possess only the attribute of power are referred to as "dormant stakeholders"; those who possess only the attribute of legitimacy are classified as "discretionary stakeholders", whilst holders with a sense of urgency are "demanding stakeholders". On the other hand, if stakeholders possess two of these three attributes, their relevance or salience will be higher. Stakeholders who possess both power and legitimacy are referred to as "dominant stakeholders"; those with legitimacy and urgency are "dependent stakeholders", whilst those with the attributes of power and urgency are "dangerous stakeholders". Stakeholder salience is highest when stakeholders possess all three attributes; such individuals or groups are definitive stakeholders. These dynamics or attributes change or are shaped within a timescale and in accordance with the issues under consideration.

This theory is relevant to the paper, which basically argues that any research or study on the governance of natural resources and the associated institutions need to identify the key stakeholders so that reasonable brainstorming is carried out among relevant actors. Effectively identifying various communities for purposive engagement provides a solid springboard for the development of social capital, which includes trust, norms and networks of relationships that could lead to more informed and widely acceptable policy outcomes (Putnam, 1993; Wondolleck and Yaffee, 2000). However, the co-management of natural resources presents some complexities especially in the determination of stakeholders; for instance, moving from the traditional notion of communities as homogenous and relatively small with shared norms, the contemporary literature underscores a notion of community as more heterogeneous and conflictual (Agrawal and Gibson, 1999). Duane (1997) identifies three main types of communities (stakeholders) which it is critical to engage or call upon for effective participation in collaborative natural resource governance:

(1) Communities of place: these are stakeholders who are tied to physical space through geography – in other words, the physical or administrative borders where the resource in question is located needs to be engaged. This is critical as most ecosystems or natural resources span two or more geographical units; engaging one party and neglecting the other could create more conflict than not starting any

engagement process at all, because the neglected places would perceive sabotage and state/external support for the others.

(2) Communities of identity: these are individuals who are also tied to each other through social characteristics and may also be scattered in more than one place. In any negotiation regarding a particular resource, especially in the African setting, where there are various ethnic groups, which has often been a source of brutal conflict, it is important to identify which social groups have a stake in the resource. Community of identity could refer to the religious, cultural or blood ties that bind a people together. One cannot fail to appreciate the significance of the invisible hands of informal institutions or traditional institutions here.

(3) Communities of interest: these are individuals and groups who may not be bonded by social or family relations or by geography, but their commonalities lie in the benefits they receive from a particular resource or the cost they impose on it.

These three primary stakeholders (at times membership may overlap), together with an array of other secondary communities such as interest groups, private actors, non-governmental organisations, all need to be engaged effectively.

Proper scoping would enable government agencies to decide which communities are relevant and at what point in time; this is what the American public Policy Analyst William Dunn refers to as "boundary analysis" (Dunn, 2004). Dunn posits that in problem structuring, proper boundary analysis helps in identifying relevant stakeholders, who can provide a more holistic view of the problem to be solved; such a holistic view enables effective solutions that do not result in a Type (III) error.

Carlsson and Berkes (2005) present seven key complexities which should not be taken for granted, else co-management of environmental resources will face real implementation hiccups. Therefore advocates and practitioners of co-management processes should take into consideration the complexities of: the state and its agencies; the community and its heterogeneity; the dynamism and iterative nature of the system; and the (enabling) conditioning factors that exist to support the system. Other complexities associated include complexities of: co-management as a governance system; co-management as a continuum involving adaptive learning and problem solving; and the complexities of the ecosystem producing the resources in question. The state is a major stakeholder in all natural resource co-management efforts; in contemporary times, modern constitutions and formal institutions provide the state and its agencies with the power and authority to manage and regulate natural resources. The state is complex and, in most cases, more than two state agencies are in charge of managing natural resources and perhaps each of these may have various arrangements of its own with the communities or stakeholders (Carlsson and Berkes, 2005). In some cases other stakeholders who are to be recognised by the state and its agencies are explicitly or implicitly mentioned, but the actual authority resides in the state. The particular role of the state institutions and agencies as well as coordination is critical for the success of co-management models; they need to serve as catalysts and allow other stakeholders enough responsibilities and authority to deliberate (Muller, 2010).

This paper has attempted to demonstrate the complexities associated with natural resource co-management as well as the corresponding institutions that underpin these processes. What appears paradoxical is that most studies that undertake research on this "complex" phenomenon are tempted to adopt a reductionist approach (see Maciejewski *et al.*, 2015), or ignore the input of communities in the study (Fischer *et al.*, 2014). This point has been forcefully argued by Borrini-Feyerabend *et al.* (2004), who observe that "conventional research on natural resource management is an activity carried out by experts (usually outside experts), which involves local actors only as informants or labour. Local people are asked to provide

information, but are not let to elaborate on the context or meaning of such information, and even less allowed shaping questions, defining problems or testing solutions" (p. 157). Appropriate research that informs policy and consequently the quality of environmental management adopts a more encompassing form that goes beyond the traditional disciplinary boundaries and reductionist approach towards greater transdisciplinarity.

3. Methodology

The paper undertakes a critical stage review of classical and recent empirical studies, mainly drawn from journal articles and scholarly books. The following four search domains – Sciencedirect, Emeraldinsight, TandFonline and Google Scholar – were largely used based on their relevance to the study and accessibility to the researchers. The literature search involved all terms approximately related to institutionalism in natural resource co-management: "institutions and co-management", "rules and power sharing in co-management", "institutionalism in natural resource governance", "institutions and collaborative environmental governance". These and other search terms were combined in different ways to obtain a large pool of literature relevant to the study. The large pool of articles from these sources was initially sorted for relevance by skimming through their abstracts. After the selection was made, all abstracts were independently reviewed by each of the three authors. At the end of the process, the authors met to eliminate duplicates and made a shortlist of abstracts for detailed and systematic review. Throughout the process, whenever opinions differed over inclusion of a particular paper, a final decision was subsequently made following discussion and a majority decision by the three researchers. The purposive sampling technique was used to select the appropriate literature from the secondary sources relevant to institutions, co-management and transdisciplinarity.

4. Discussion: towards transdisciplinary research (TD)

In this section the paper discusses the philosophical assumptions underpinning a TD research approach; this we do by discussing its ontology and epistemology with the aid of models. The section ends with a discussion of the "four-phase" process involved in undertaking the TD study and its appropriateness to natural resources governance research.

A TD approach connotes research that cuts across academic boundaries, actors, fields and approaches in a process of co-designing and co-producing practical knowledge that is more transformative. The complexity of social phenomena (natural resource governance) and the focus on disciplinary boundaries made Brewer (1999) comment in exasperation that "the world has problems, but universities have departments" (p. 328). The complexities of contemporary and future socio-ecological phenomena (challenges) require a solution (research process) involving a collaboration between researchers, ideas, disciplines and fields from diverse orientations.

Reviewing relevant literature on TD, Pohl (2005) observe four key trends facilitating TD research. First, TD takes into account the complexity of an issue – meaning the complex system of factors that together explain the issue's current state and its dynamics; it addresses both science and society's diverse perceptions of an issue. Second, TD sets aside the idealised context of science in order to produce practically relevant knowledge. Third, it deals with the issues and possible improvements of the status quo that are involved in balancing the diverse interests and inputs of individual stakeholders and disciplines (Pohl, 2005, p. 1161). Finally, TD research is more oriented "towards the common interest". For instance, Blaikie (2006) maintains that in spite of the theoretical benefits of co-management, at the end of the day it is what actually occurs in the field that determines its worth. If co-management of natural resources could indeed create value (Leach and Sabatier, 2005; Mandarano, 2008; Muller, 2010; Rogers and Weber, 2010), this has much to do with the institutional designs and enforcement complementarities. It is therefore essential that TD brings stakeholders on board

who are able to synthesise ideas. Perhaps, it is through this iterative process that co-management is viewed as a process of continuous learning to improve collaborative outcomes (Cundill and Rodela, 2012; Reed *et al.*, 2014).

The complexity and heterogeneity of actors in co-management of environmental resources requires a transdisciplinary research (TD) approach, which is deemed more appropriate to co-design and co-produce knowledge on institutional designs, and how best they are (or could be) enforced in the co-management of natural resources. The growing consensus on the complexity of environmental resources has made TD an emerging design that underpins contemporary research (see Lang *et al.*, 2012; Ignatieva *et al.*, 2015).

With natural resources co-management, however, the situation is more complex and "ill-defined". In this case there are overlaps between community members' exploitation of the resources for survival (economic) and the need for resource protection (ecological); and between dealing with local protection and conservation systems *vis-à-vis* formal governance and conservation structures. In co-management of natural resources, the stakeholders are multifaceted and consequently the institutional design as well as enforcement requires an integrated approach. It is therefore prudent that a study of this phenomenon should engage in a more iterative and transdisciplinary process that co-designs and co-creates contextualised knowledge that is viewed as legitimate and usable.

Transdisciplinary research focusses on complex societal phenomena and emphasises the relevance of creating a process that stimulates mutual learning from the diverse values, goals and resources that individuals contribute. In other words, TD is more focussed on co-designing a study and co-producing knowledge that is more usable and relevant to the academic community and users (Lang *et al.*, 2012). A TD approach offers an opportunity to study and proffer hands-on solutions that address complex governance issues by integrating an array of theoretical and methodological approaches across the socio-ecological space (Lang *et al.*, 2012).

4.1 Ontology of TD

Ontology deals with the nature of reality; in other words, it answers the question of what constitutes reality. Obviously, owing to the iterative process and collaborative nature of TD, it definitely has a contested view of reality relative to the various actors in the knowledge production process. Relativism is the view that reality is subjective and differs from person to person (Guba and Lincoln, 1994). Reality emerges when consciousness engages with objects that are already pregnant with meaning (Crotty, 1998). There are multiple levels of reality, that is, perspectives and worldviews which are mediated by a "Hidden Third" (explained below), hence it is imperative to seek diverse perspectives on any human problem because the intention is to integrate many levels of truth while generating new TD knowledge (Nicolescu, 2010). TD ontology recognises the complex and dynamic relationships among multifarious realities organised at three levels, culminating in at least ten realities as discussed below:

(1) The internal world of humans: the level of reality where human consciousness flows, that is, the TD subject (this entails, inter alia, political, social, historical and individual realities).

(2) The external world of humans: the level of reality where information flows including inter alia environmental, economic and cosmic/planetary realities.

(3) The Hidden third: the level mostly latent and embedded in peoples' experiences, interpretations, descriptions, stories, representations, images and formulas. (This includes the culture and art, religious and spiritual belief systems). TD acknowledges these multiple realities and attempts to incorporate them in knowledge production (Nicolescu, 2010; McGregor, 2012).

4.2 Epistemology

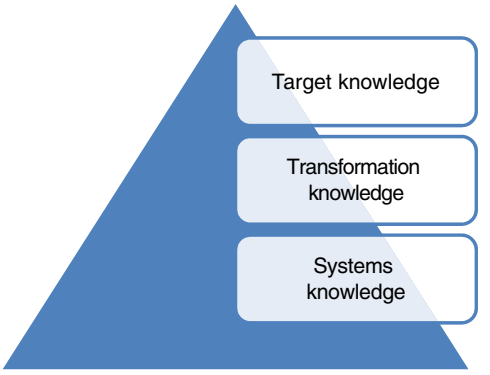
The root of the concept "epistemology" is the Greek word *episteme*, which simply means "knowledge". Epistemology is concerned with what constitutes knowledge and the processes involved in obtaining knowledge (Trochim, 2000). It also indicates the relationship between the researcher(s) and the participants or the problem being investigated, the processes involved in knowing as well as what constitutes acceptable knowledge (Krauss, 2005).

As with its varying ontology, TD epistemology involves an emergent knowledge obtained through ideas that have been synthesised from the interaction between different social actors who are integrated into an expanding field of research inspired by scholars from diverse backgrounds together with practitioners and community members by bridging the barrier between science and society (Flinterman *et al.*, 2001; Regeers and Bunders, 2003; Nicolescu, 2012). The entire process entails active consultation with and participation of the communities of practice, which involves inter alia the research team, practitioners and community members (see Regeers and Bunders, 2003). If research is conducted in this way, the research outcome is able to identify: how institutions in the co-management process have behaved in the past; the forces that have shaped contemporary institutions as well as the enforcement laxities; and how actors want future institutional arrangements (with the necessary requirements) to address natural resource challenges. The above could be achieved through a TD process whose outcome produces three main forms of knowledge: systems, target and transformation knowledge (Pohl and Hirsch Hardon (2007), as explained below (see Figure 2):

(1) Systems knowledge seeks answers to questions on the origins of co-management and its corresponding rules and power relations (institutions), possible development of the institutions, benefit structure as well as interpretations of the institutional arrangement.

(2) Target knowledge seeks answers to questions related to determination and explanation of the need for change, improvements in the status quo, desired goals and appropriate practices. It seeks knowledge about a desired or ideal situation, suggesting a zeal to move a step ahead to improve or transform the situation.

(3) Transformation knowledge seeks answers to questions about the socio-technical, legal, cultural and other mechanisms required to act, so as to transform existing practices and introduce desirable ones. It seeks knowledge to shape the transition from the current to a target situation (what it is and how to get there).

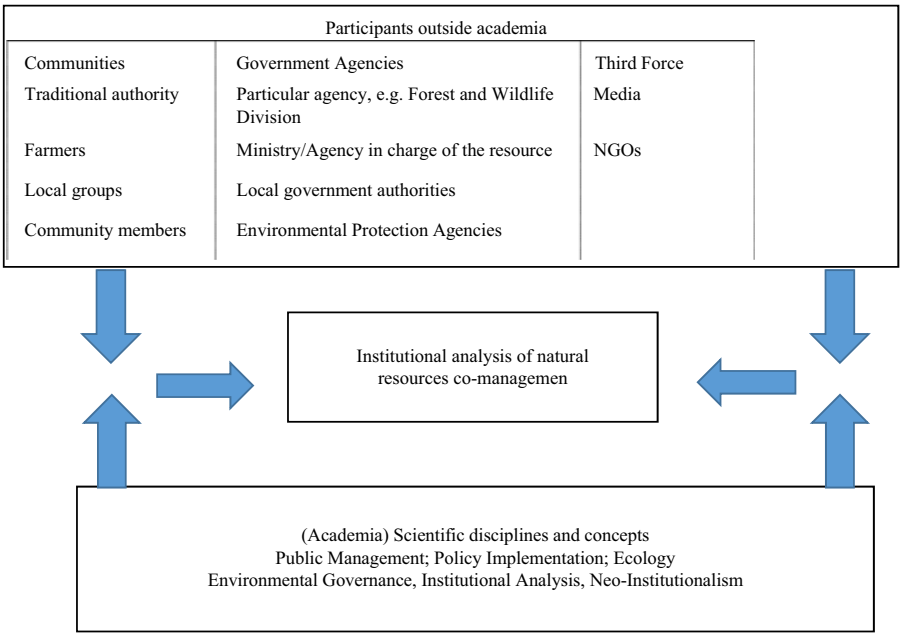


Sources: Adapted from Pohl and Hirsch Hardon (2007), Messerli and Messerli (2008)

Figure 2.
Knowledge obtained from TD in co-management research

A more reductionist approach may mostly stop at seeking systems knowledge by perfectly modelling the prevailing challenge or situation (Maciejewski *et al.*, 2015). A TD process jointly carries out this phase, forecasts for a desirable situation, and designs the requirements for such transformation or brighter future. With the TD participatory process, the solutions are more context-specific and legitimate, and compliance would also be less problematic (Walter *et al.*, 2007; Pohl, 2008). A TD research approach adopts a multi-sectorial and iterative process that harnesses knowledge and expertise from academia, practitioners and community members. For a study on an institutional assessment of the co-management of natural resources (such as forests and wildlife), Figure 3 indicates the key participants to draw on.

The framework above serves as a guide to prospective researchers examining natural resource co-management institutions. However, depending on the study context and specific country agencies, the framework could be adaptable. For instance, most countries give their agencies different names, although their functions do not vary widely across countries. Any attempt to arrive at more holistic and transformational knowledge requires a team of researchers from inside academia (diverse backgrounds and disciplines), practitioners and state agencies (who have more practical experience and are crucial in enforcing research outcomes). More importantly, there is a need to involve different sections of the resource community, who possess contextual information and who are mostly the primary resource users (they will be the ones affected by the institutions as well as crucial when it comes to enforcement of local natural resource institutions). Involving community members and paying attention to local stakeholders (e.g. landholders, those with access rights) in research on natural resource governance helps to avoid legitimacy challenges (Brown and Lassoie, 2010) and it enables effective adoption, enforcement and monitoring of research outcomes (Górriz-Mifsud *et al.*, 2016). Various groups who have a stake in the tenure right



Source: Authors' construct

Figure 3.
A framework for TD study

systems, including vulnerable and marginalised groups, need not be relegated to the background. In discussing an integrated policy network model, Teye (2013) contends that by neglecting vulnerable groups during research on natural resources and the associated policy formulation phase, these "marginalised groups are able to depend on their networks with forest guards to harvest forest resources illegally" (p. 70). It is within this context that community members should be actively engaged in the research process, so that the outcomes would largely acquire "community ownership" and enforcement will gain relative legitimacy and patronage with less sabotage.

Drawing these actors together in a joint research process through various phases of interaction, TD produces more context-relevant research outcomes.

4.3 Application of the TD research process: from theory to practice

We argue that to bridge the gap between theory and practice depends not so much on the good intentions of the researcher as on the process itself. The researchers can, by following certain process design specifications, try to maximise the probability that the outcomes of a TD project will embody the TD paradigm's philosophy of co-production of societally relevant solutions. We propose that a four-phase iterative approach should form the basis for the design of a TD study (see schematic view of the TD process in Figure 4). The four fundamental phases are the initiation phase, formulation phase, execution phase, and communication and utilisation phase.

The phases are inter-linked and iterative, where feedback is always obtained from one process to the other as well as through a "backward loop". Each process interacts with the others in a more encompassing form and is not purely unidirectional (i.e. the phases are closely interwoven).

The initiation phase (also known as the formative phase of team and trust building) involves recognition of the research problem or interest, where the relevant research team is

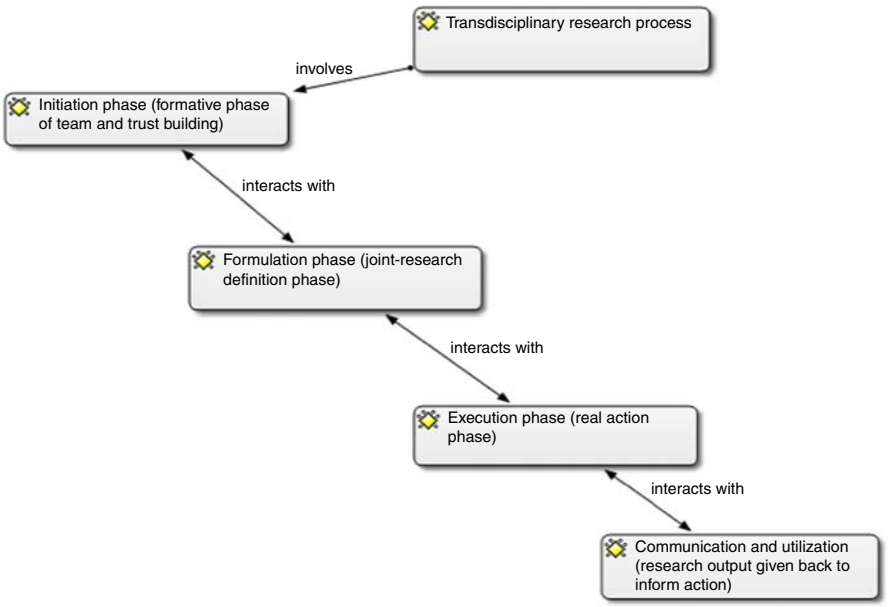


Figure 4.
An iterative four-point TD process

Source: Authors of this paper

built around the research concept. The convener or team leader needs to communicate the concept (preliminary problem observation or research interest) to potential (relevant) team members to get them to buy into or express interest in being part of the research project. The team (as illustrated in the framework above) is to be drawn from relevant academic disciplines, practitioners and community members (see Figure 3). The phase requires a familiarisation process and an account of the modus operandi of the team, allotment of specific tasks, meeting periods and venues. It also involves familiarising themselves with the research area and individuals or groups associated with the phenomenon or case to be researched (see Norris *et al.*, 2016 for strategies in TD team formation).

The formulation phase (also known as the joint-research definition phase) involves active brainstorming which produces and synthesises knowledge, ideas or opinions from a variety of actors across disciplines, practices and orientations on a particular research interest or problem. The paper conceptualises this as "formulation" because it requires the generation of various ideas, alternatives and possible problem definitions and approaches; these are then synchronised and synthesised. This is the critical phase during which the team of researchers reaches an appreciable level of agreement on "common terms" regarding the research project; this involves inter alia jointly defining and developing the research concept, designing the objectives and appropriate questions as well as the approach (see Schäfer and Kröger, 2016). If the research project is a thesis, this stage involves actively engaging with project supervisors, reviewers from other faculties, practitioners and community members. This approach, especially, engagement with non-academics (practitioners and community members), helps to define the research problem and how best to carry out the project. In this way the real-world problem therefore serves as a boundary object that draws together various stakeholders with experience, expertise or some other "stake" to jointly proffer solutions (Clark *et al.*, 2016; Lang *et al.*, 2012).

The execution phase represents the action part of the research process, which involves a search for a joint solution through appropriate methods, designs and approaches adopted to reconcile the various form of knowledge and perspectives coming on board. The TD process enables the researchers' idea to be executed or carried out in a more functional and dynamic way; here the procedures, specific approaches and time lines are drawn to guide the process (see Lang *et al.*, 2012). What makes this interesting is that all participants design the most feasible and nearly best approach with respect to the context.

The communication and utilisation phase serves as the ultimate goal of TD research as it seeks to address real societal (natural resource governance) problems. This final phase involves communicating the co-designed and co-created research outcome (emergent knowledge) to relevant actors and authorities to be implemented in a way that brings about a significant improvement in the current situation. In TD this phase is executed with relative ease and knowledge is more likely to be enforced to bring about societal improvement, since the respective stakeholders (practitioners and community members) were involved in the co-creation process, and hence the co-designed solutions would be deemed legitimate and easily applicable (see Walter *et al.*, 2007; Schäfer and Kröger, 2016).

4.4 Relevance of TD research for natural resource governance and institutionalism

On the basis of the review so far, we have argued for a TD approach in carrying out research that addresses institutional assessment of natural resources co-management. The reasons for implementing a TD approach are briefly outlined below.

First, natural resource management has gone through an evolution, from being largely bureaucratic and state-centric through to community-based management to co-management or collaboration. The contemporary emphasis is on co-management, which involves power sharing, and power sharing requires institutions to structure it. The process is inter-relational and involves a complex range of stakeholders, which in turn requires a TD research approach

to understand the trajectory and performance of institutions. A study that adopts a TD approach will be able to elicit target, systems and transformation knowledge (see Figure 2).

The intricacies, high stakes and complexities associated with the co-management of natural resources, coupled with context-specific issues, require a TD knowledge that is co-created and developed from the specific context. Especially from the later twentieth century, the management of natural resources moved from the archetypical fortress approach towards adopting a networked system which is now referred to by various names, inter alia environmental governance, collaborative process, co-management, joint forest management, and community-based natural resources management. Though conceptually each of these varies slightly, the underpinning similarity among all of them is an emphasis on multi-actor governance, the interplay of divergent stakeholders, and a network of individuals and groups who jointly manage natural resources (Agrawal and Gibson, 1999; Carlsson and Berkes, 2005). For instance, Carlsson and Berkes (2005) argue that co-management should not be viewed as a two-way process, just between the state and community; this will make it seem that the community is simply a homogenous entity. However, actors within the community are heterogeneous and diverse. Co-management of environmental resources involves power-sharing arrangements, mutual responsibilities and benefits (Leach *et al.*, 1999; Blaikie, 2006). This suggests that co-management of environmental resources is a complex, "fuzzy", "wicked" and "ill-defined" phenomenon that requires a more transdisciplinary process to assess the effectiveness of the institutional arrangements underpinning contemporary co-management processes.

Institutions have a backward and forward loop, in that they have a past as well as contextual factors that have shaped contemporary institutions which underpin natural resource co-management. More importantly, TD research produces, among other things, transformation knowledge, which is required to address prevailing laxities in institutional processes and enforcement. This will make it relatively easier to co-opt members since they co-created the solutions and way forward.

Finally, natural resources *per se*, especially forest and wildlife resources, are "fuzzy" in nature in the context of sustainable development. For instance, whilst a major goal of foresters may mostly be to ensure ecological protection, the goal of the local people is largely to use the same resources for their primary survival. Because of this, the interplay between the three main values of sustainable development – economic, social and environmental – and how to strike a meaningful and agreed balance between them, is highly complex. Therefore, a study of how and why institutions have developed, how they shape people's behaviour as well as their enforcement needs to adopt systems thinking, because the entire process is complex and fuzzy, and the stakes are high. The TD approach encourages researchers to co-develop more workable and contextual strategies that facilitate human-environment interactions and eventually boost the resilience of social-ecological systems.

It should, however, be acknowledged that the iterative nature of TD study, the stakeholders involved, its ontological and epistemological flexibilities make the process somewhat laborious, albeit useful, to provide effective research outcomes that impact on society.

5. Conclusion

This paper has reviewed the contemporary literature on the co-management of natural resources. The paper has observed that, even though recent publications tend to emphasise the role of institutionalism in natural resource governance, there is a need for a more complex systems analysis. It is prudent for researchers to adopt a more all-encompassing approach that links academics and practitioners and more importantly community members in the research process. Institutional design in natural resource governance is an interesting study in that the relationship between actors, their responsibilities and powers in any particular co-management regime has a rich history often embedded in the narratives or

stories of the community stakeholders, which could better be appreciated if researchers adopt a transdisciplinary approach that links academia (lead researchers) to the non-academic world (practitioners and community members). Because it is just not enough to assess natural resource institutions and rules, TD aims at integrating science with society to co-produce relevant knowledge that would help solve natural resource governance problems and also to strengthen institutions and their enforcement. TD has a problem-solving focus; its active inclusion of practitioners and landholders/communities throughout the research phases makes the communication of research outcomes to communities very much easier and more readily accepted, and it thus commands greater legitimacy, which makes solutions easier to implement or enforce to improve governance of resources (see Benham and Daniell, 2016). In other words, TD involves a study with landholders/communities to co-create legitimate and practicable solutions towards finding an institutional system that encourages the sustainable use of natural resources in the service of poverty reduction and the empowerment of marginalised communities/people.

The more reductionist (traditional) approach to design purely quantitative models to unilaterally assess complex resource governance issues and attempt solutions hardly commands legitimacy these days and conclusions may end up fading away in academic journals, which means they may not really impact on the study communities *per se*. The future of communities, resources and the ability to link research to policy and implementation requires a TD process which recognises systems knowledge, target knowledge and transformation knowledge, all of which are relevant to solving societal problems. It is high time researchers on resource governance adopted a more TD approach to incorporate scientific knowledge into the knowledge and experiences of practitioners as well as the local knowledge of community members so as to co-produce a more legitimate knowledge that would have a greater impact on society. The TD approach to assessing resource governance issues offers a "tailor-made approach" to solving real societal problems. When one wants to have a suit made for oneself, one goes to the tailor to be measured and the suit is cut and sewn appropriately based on the specific size and specifications. Similarly the TD approach suggests that in knowledge generation and proffering solutions to complex societal problems, the specific context, actual practitioners and people are to serve as points of contact and active participants in the research process. On the other hand, if one wants to buy an already made suit, one usually goes through a tedious process of trying on different suits (sizes vary based on designer or country of origin) before identifying which one of the alternatives fits one's size and shape relatively well. This is far more tedious than the other scenario where the measurement is done in advance and would wear it to check appropriateness after perhaps a little alteration. Societies cannot go through such trial-and-error processes of importing other knowledge into communities experimentally. In short, the specific complexities of societies and their realities should be factored into the knowledge-production process. Involving researchers, communities and practitioners more closely for the purpose of conducting research and structuring the problem brings out and synthesises new information and ideas which may not have occurred to the researchers individually, or if they had just sat in their armchairs to design questionnaires to be filled in by community members and practitioners. The synthesising, synergistic, iterative and interactive nature of the TD approach develops new ideas which enrich the body of knowledge previously held by researchers about the particular resource.

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