

Adaptive comanagement in developing world contexts: A systematic review of adaptive comanagement in Nusa Tenggara Barat, Indonesia

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ABSTRACT

Nusa Tenggara Barat (NTB) province, Indonesia is beset by high vulnerability to climate change and weak adaptive capacity to address its effects. Livelihoods in the province are intimately tied to increasingly scarce and contested ecosystem goods and services. The population's climate vulnerability is further exacerbated by social, economic, and cultural drivers of vulnerability, such as rapid population growth, pervasive corruption, and inadequate community participation in planning processes. Scholars and practitioners have begun conceptualizing and implementing adaptive comanagement (ACM) approaches in NTB. ACM is an environmental governance approach for complex, multi-scale social-ecological systems facing uncertainty and rapid system changes. ACM aims to forge vertical and horizontal links for shared learning between the various actors of multi-level resource management systems. The province's markedly heterogeneous physical and social geographies present a unique opportunity to glean lessons applicable to a range of contexts including rural communities, island geographies, the Indonesian archipelago, the tropical Asia-Pacific region, and the developing world more broadly. This paper provides a systematic review of efforts to conceptualize, implement, and evaluate adaptive comanagement approaches in Nusa Tenggara Barat. In doing so, it characterizes the literature, discerns salient thematic components, and identifies areas for further research and action on the conceptualization and implementation of adaptive comanagement.

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1. Introduction

A growing focus of environmental governance scholarship and praxis seeks to identify and engage with the dynamics that drive nature-society interactions, ecosystem sustainability, and human development. These efforts emphasize the complex interdependence of social-ecological systems and the consequent need for integrative, multi-scale institutional arrangements to promote resilience and adaptive governance (Berkes et al., 2003; Folke et al., 2005; Basurto and Ostrom, 2009). Approaches typically emphasize learning, collaboration, and building adaptive capacity to deal with complexity and uncertainty (Armitage et al., 2008; Plummer and Armitage, 2010; Rodima-Taylor et al., 2012; Plummer et al., 2013). An emerging approach aimed at improving the governance of complex social-ecological systems is adaptive comanagement (ACM).

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Drawing insights from various fields of environmental governance, ACM blends adaptive and collaborative themes in resource management to engender a novel approach that incorporates complexity science, systems perspectives, and resilience thinking (Plummer et al., 2012). Whereas adaptive management focuses on learning-based approaches to accommodate change and uncertainty over medium to long-term timeframes, comanagement focuses on connecting individuals and agencies across multiple organizational, institutional, and geographic levels (Folke et al., 2003; Berkes et al., 2007). Plummer et al. (2012: 1) thus define ACM as a process that forges links, both horizontal and vertical, for shared-learning-by-doing between various actors, over a medium to long-term horizon. It is multi-scale in spatial scope and concerned with enhancing and including the capacity of all actors with a stake for sustainably managing the resource at hand.

Although ACM literature has been shifting from primarily theoretical contributions and foundational case studies, there has been relatively few case studies of the approach in practice in the developing world. Examples of implementation of adaptation approaches in communities beset by weak adaptive capacity and rapid system change are even fewer (Butler et al., 2016a). Notably however, in recent years, Nusa Tenggara Barat Province (NTB), Indonesia has been used as an operation site to conceptualize, implement, and evaluate ACM strategies. The marked heterogeneity of NTB's physical and social geographies presents an opportunity to glean lessons about effective ACM strategies across a wide variety of contexts. These lessons may be broadly applicable to communities that share similar contexts such as rural communities, island geographies, the Indonesian archipelago, tropical Asia-Pacific region, and or developing world more broadly.

This paper provides a systematic review of adaptive comanagement strategies in Nusa Tenggara Barat, Indonesia. The paper is organized as follows. First, we briefly describe the methodological approach and discuss its justifications and limitations. Second, we describe the geographic, social, economic, and political backdrops in NTB to provide the relevant contextual information necessary to more reliably assess ACM as a complex social intervention. Third, we synthesize and extract salient thematic components and patterns that emerge from our review. Fourth, we discuss the lessons learned from the findings, how the findings contribute to the broader ACM literature, and areas for further research and action on adaptive comanagement.

2. Methodology

2.1. Theoretical approach

Systematic literature reviews attempt to “identify, appraise and synthesize all relevant studies (of whatever design) to answer a particular question (or set of questions)” (Petticrew and Roberts, 2006:9). As such, systematic reviews are key sources of evidence-based information from which policy-makers and practitioners can draw (Petticrew and Roberts, 2006). Although single studies can produce valuable insights to inform policy and practice, critically appraising, summarizing, and examining a range of insights into a manageable form provides a more robust understanding of the question at hand. Distilling a range of research also mitigates research biases and allows decisions to be made on a more transparent and potentially defensible basis (Petticrew and Roberts, 2006).

As opposed to a traditional review, a systematic review seeks to generate insight by going beyond the summary of different studies. By focusing on synthesizing evidence across the range of questions posed by policy-makers and practitioners, systematic reviews more effectively employ existing research to develop and support evidence-based policies and decisions (Snijlsteit et al., 2012).

Single case studies on adaptive comanagement in NTB have produced practical contributions to development planning in the province and valuable insight for broader ACM scholarship and practice (Suadnya et al., 2011; Bohensky et al., 2016; Butler et al., 2016a; Wise et al., 2016). These contributions have been particularly useful for scholars and practitioners working in contextually similar conditions such as rural communities, island geographies, and the developing world more broadly. However, discerning patterns, underlying themes, and lessons across the case studies necessitate a broader systematic review and analysis. A more robust, reliable summary of ACM in Nusa Tenggara Barat could prove useful in identifying emerging thematic components and/or gaps in knowledge, therefore guiding further research.

It is important to acknowledge that efforts to conceptualize, implement, and evaluate ACM strategies in Nusa Tenggara Barat are relatively nascent and limited in scope. Systematic reviews remain valuable in such a situation by highlighting the absence of information, revealing limited empirical underpinnings, identifying conceptual gaps, and directing future research efforts accordingly (Petticrew and Roberts, 2006). Instead of waiting for the accumulation of more information, systematic reviews can productively guide prospective research towards more insightful scholarship and effective practice.

Adaptive comanagement strategies are complex interventions underpinned by strong social components that determine how the strategies are delivered and received. Thus, this systematic review is broadened to also include a discussion of the relevant contextual information needed to more accurately assess ACM themes and patterns. Such information includes data and information on the geographic, climatic, social, economic and cultural context of Nusa Tenggara Barat.

2.2. Methods

The systematic review of adaptive comanagement in NTB follows a five-step method. This framework is informed by qualitative-oriented synthesis-based methodologies in social sciences (Petticrew and Roberts, 2006; Carter and Little,

2007; Crowther and Cook, 2007; Barnett-Page and Thomas, 2009; Snilstveit et al., 2012). The five steps are as follows: research objective definition, search protocol definition, comprehensive literature search and screening of search results, analysis of results, and discussion of the findings.

2.2.1. Research objectives

The review was framed by the following research objectives: (1) Synthesize relevant research on ACM in Nusa Tenggara to characterize the literature, (2) discern salient thematic components and patterns emerging from the literature and, (3) identify areas for further research in ACM scholarship and practice. Key analytical considerations that inform these research objectives include relevant contextual information, variables contributing to outcomes, evidence of consistent findings, and gaps in knowledge or evidence (see Fig. 1).

2.2.2. Search protocol

The search protocol employed three methods to populate the data set. The first method involved conducting searches using standard electronic academic databases, relevant journals, and Google Scholar. Key search terms included adaptive comanagement, adaptive management, climate change adaptation, adaptive capacity, vulnerability, and resilience. Key search terms were all followed by “Nusa Tenggara Barat” or “West Nusa Tenggara” as a preliminary exclusion criterion.

The second method involved searching in the comprehensive document reviews undertaken by the Center of Excellence on Climate Resilience in Agriculture (CoE CLEAR) hosted by the University of Mataram in Mataram, Nusa Tenggara Barat. CoE CLEAR’s document reviews compiled peer-reviewed and non-peer reviewed “gray literature” on climate change adaptation in NTB. The gray literature includes reports produced by collaborations between governmental, non-governmental, academic, and development organizations, including the University of Mataram, UN World Food Programme, Australian Center for International Agricultural Research (AICAR), Commonwealth Scientific and Industrial Research Organization (CSIRO), and Climate Change Adaptation Project (CCAP).

The third method involved a “snowball procedure,” also known as “pearl growing,” whereby studies accumulated by the first two methods are analyzed to find relevant studies that reference or are referenced by key studies relevant to the research objective.

2.2.3. Literature search and screening

The initial search yielded 106 citations. The first, second, and third search methods contributed 61, 22, and 23 citations, respectively. Exclusion criteria for primary and secondary screening were then set. The primary screening considered the title, abstract, keywords of the citations according to the criteria of geographical location (Nusa Tenggara Barat), language (written in English), temporal scope (between when ACM was first introduced in 1997 until the present [December 2016]), and relevance of topic (climate change adaptation, community vulnerability, social-ecological systems, adaptive capacity-building, natural resource management, environmental governance, etc.). As a result, 62 citations were excluded from the review.

Secondary screening then involved retrieving the full text of the study and determining the relevance of its research objective to adaptive comanagement in Nusa Tenggara Barat. More specifically, the research objective or findings must contribute to the conceptualization, implementation, and/or evaluation of ACM strategies in NTB. This contribution can be made implicitly or explicitly through theoretical or empirical analysis. Theoretical analysis primarily involves conceptualization of ACM whereas empirical analysis primarily involves the presentation of primary data drawn from the application or assessment ACM practices. As stated earlier, ACM is defined as an iterative process of forging links, both horizontal and vertical, for

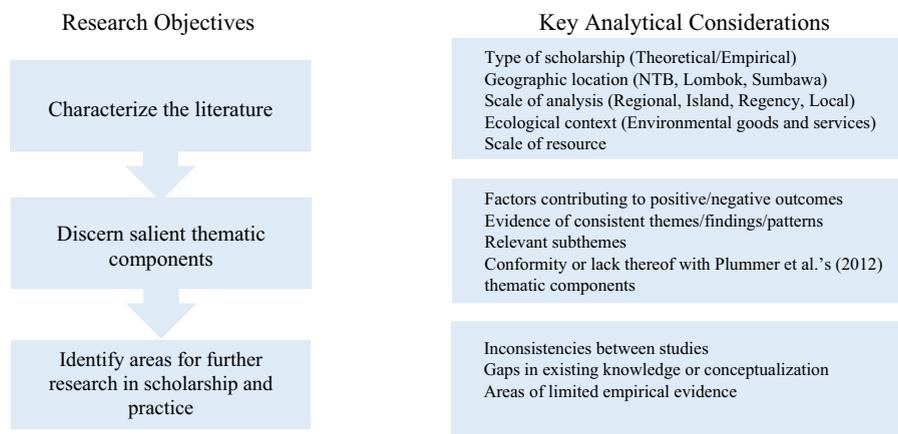


Fig. 1. Diagram of research objectives and key analytical considerations.

shared-learning-by-doing between various actors at multiple scales. It is multi-scale in spatial scope and concerned with enhancing and including the capacity of all actors with a stake for sustainable managing the resource at hand (Plummer et al., 2012). Therefore, the research objective must address one or more of ACM characteristics, including but not limited to, institutional development, social learning, and collaborative management. Secondary screening resulted in the exclusion of an additional 20 citations, ultimately yielding 24 citations for use in the review.

2.2.4. Analysis and coding

A thematic synthesis approach was applied to critically analyze the citations. Thematic synthesis is an inductive methodology with a qualitative orientation that aims to systematically generate hypotheses from data through a comparative analysis (Snilstveit et al., 2012). This approach involves three steps: coding of text, developing descriptive themes, and generating analytical themes (Snilstveit et al., 2012). These steps are considerably informed by the systematic literature review undertaken by Plummer et al. (2012). The first step, coding, refers to a process whereby textual data are read and key concepts are extracted, characterized, and given an affixed label (Glaser and Strauss, 2012). The second step involves grouping the coded passages into similar conceptual categories and developing descriptive themes (Snilstveit et al., 2012). However, this paper blends inductive and deductive approaches by then using the conceptual categories and descriptions that emerged from the systematic review of ACM undertaken by Plummer et al. (2012). Focusing on how closely the thematic components conform in a more granular context allows for a comparison and critical discussion of broader ACM themes. The third step requires going beyond the initial themes presented in the original studies to generate interpretative analytical themes that thread together the themes in the original studies (Snilstveit et al., 2012).

2.2.5. Dissemination and discussion

The emergent themes and salient components are then summarized and discussed. We discuss the lessons learned from the findings, implications for broader ACM literature and practice, and areas for further research and action on the conceptualization, development, and implementation of adaptive comangement.

3. Nusa Tenggara Barat context

3.1. Geography and climate

Nusa Tenggara Barat province is located in the island archipelago of eastern Indonesia (Fig. 2). The province is comprised of 280 islands among which 32 are inhabited. The two principal islands are Sumbawa to the east (15,448 km²) and Lombok to the west (4725 km²). These islands feature the active volcanoes Rinjani (3726 m) and Tambora (2722 m).

NTB has a tropical climate with a monsoon season of December–April and is affected by the El Niño Southern Oscillation (ENSO), which can generate drier and/or wetter than average periods. The orographic effects of the volcanoes Rinjani and

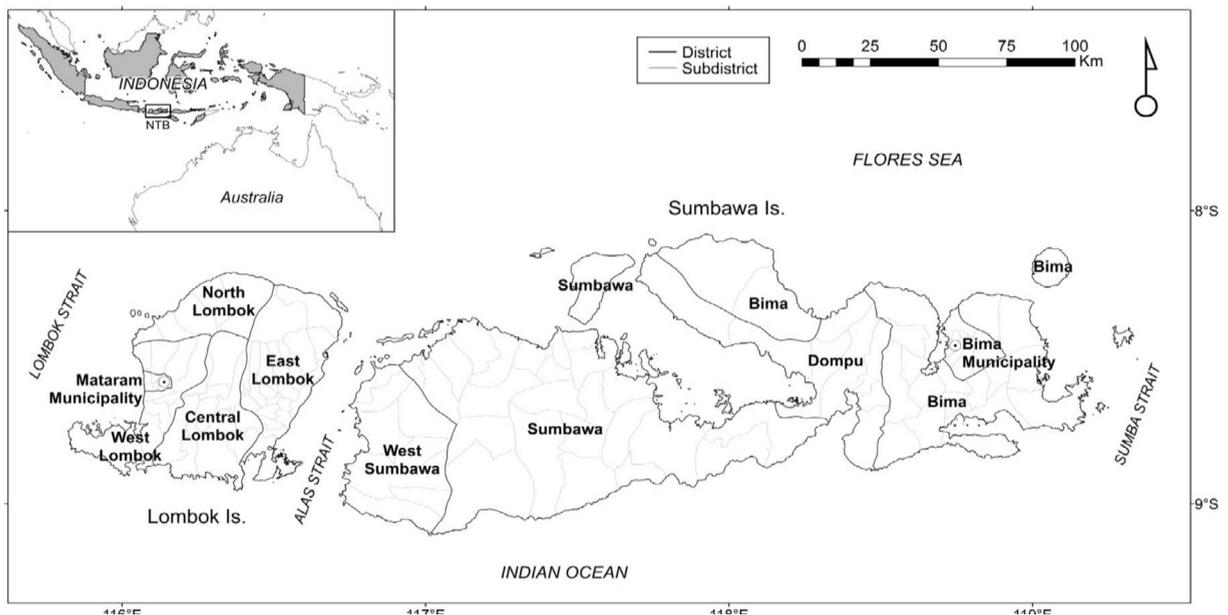


Fig. 2. Lombok and Sumbawa, Nusa Tenggara Barat (NTB), Indonesia (Butler et al., 2014).

Tambora create steep climate gradients across the islands. Combined with marked variation in soil types, these microclimates support diverse agricultural systems and livelihoods over a short distance (Yasin et al., 2007).

Under the “business as usual” greenhouse gas emissions scenario, the projected increase in average air temperatures in NTB will increase by 1 °C relative to 1961–1990 by the year 2050, and 2–3 °C by 2100 (Ministry of the Environment, 2010). This change in temperature is likely to increase the frequency and intensity of droughts, and decrease the predictability of rainfall patterns (Yasin et al., 2007). Rainfall patterns may become concentrated into fewer events (Butler et al., 2014). Due to the high variability of microclimates, changes in rainfall patterns will vary widely across the island (Kirono et al., 2016).

3.2. Society, human development, and culture

In 2015, Nusa Tenggara Barat had a population of 4.83 million and an annual growth rate of 1.29% (BPS NTB, 2016). Lombok comprises 70 percent (3.39 m) of NTB’s total population and features a high population density of 716 people/km² compared to 94 persons/km² in Sumbawa (BPS NTB, 2016). Current growth rates project NTB’s population to reach 6.37 million by 2050, increasing Lombok and Sumbawa’s populations densities to 943 people/km² and 124 people/km² respectively (Fachry et al., 2011).

Indonesia’s Human Development Index of 0.684 situates the country in the medium human development category (UNDP, 2015). However, in 2015, Nusa Tenggara Barat had the fifth lowest Human Development Index (0.651) among Indonesia’s 34 provinces, reflecting low levels of life expectancy, literacy rates, education and per capita income (BPS Indonesia, 2015). Poverty rates have decreased significantly in the past two decades, falling from 30 percent in 2001 to 17.05 percent in 2014 (BPS NTB, 2015). Poverty rates vary widely across districts and are most prevalent in rural areas, where 58 percent of the population lives (BPS NTB, 2016). Assessments of economic drivers and livelihood typologies in NTB reveal gross domestic product (GDP) and livelihoods are largely dependent on ecosystem goods and services, such as agriculture, aquaculture, fisheries, and mining (Fachry et al., 2011; Rochester et al., 2016).

The predominant religion in NTB is Islam (97 percent of the population). In Lombok, Islam was blended with the ruling Balinese Hinduism and ethnic Sasak animism, producing today’s mixture of Muslim and Balinese customs, institutions, and customary decision-making (Fachry et al., 2011). Thus, decision-making at all levels of society is patriarchal in accordance with Islamic and traditional law (*awig-awig*) (Sjah et al., 2006).

3.3. Development programs and planning

Since the Asian Economic Crisis of 1997 and consequent fall of Indonesian President Suharto in 1998, Indonesia’s governmental and institutional organization underwent considerable transformation and now remains in a state of flux. Under the policy of “Reformasi” the central government retained its centralized planning system, but decentralized political authority and decision-making across Indonesia’s provinces and districts (Antlov, 2003). The strengthening of localized autonomy, democratic decision-making, institutional planning led to a proliferation of provincial, district, and local actors and initiatives. Consequently, coordination became increasingly complex, often undermining national and regional development planning (Butler et al., 2016a).

Since the process of decentralization began, NTB governors emphasized enhancing social and economic development, particularly through agriculture, aquaculture, and tourism (Fachry et al., 2011). NTB also benefits from various international donor programs that fund education, health, infrastructural, and agricultural development projects. However, there is poor coordination between the government, donor, and non-governmental organizations (NGOs), increasing the potential for mal-adaptation (Butler et al., 2014).

3.4. Climate change planning

Indonesia began systematically integrating climate change mitigation and adaptation into national development planning in 2007. Prompted by the release of Fourth Assessment Report of the International Panel on Climate Change (IPCC), Indonesia’s national government developed the National Action Plan on Climate Change (RAN-PI) which aimed to guide coordination between institutions and sectors in addressing climate change through resilience, mitigation, and adaptation planning (Ministry of the Environment, 2007). This was followed by the Climate Change Sectoral Road Map (ICCSR), which established a Climate Change Trust Fund to support the integration of climate change planning into national and provincial development planning (Ministry of National Development Planning, 2009).

Nusa Tenggara Barat has been one of the most proactive provinces in Indonesia in addressing climate change. In 2010, NTB became the first province to establish a Climate Change Task Force (CCTF) with the objective of integrating climate change mitigation and adaptation into provincial development planning (Ministry of the Environment, 2010). This was informed by the Lombok Vulnerability Assessment Report, a risk-based assessment of Lombok’s climate vulnerability and adaptation potential undertaken by a collaboration between the Ministry of the Environment, NTB provincial government, German International Cooperation Agency, and World Wildlife Fund (Ministry of the Environment, 2010). However, the recommendations of the report have not been integrated into provincial development planning (Butler et al., 2016a).

Several other projects and programs have been introduced by donors, non-governmental organizations, and development organizations. Such efforts include the AusAid/CSIRO-funded Climate Change Adaptation Project, AusAid-funded Climate

Field Schools in Lombok, USAID-funded Indonesian Marine and Climate Support Project in Lombok, UN World Food Programme-funded Climate Change and Food Security Program in NTB, and the Millennium Challenge Account-funded Center of Excellence on Climate Resilience in Agriculture at the University of Mataram. These projects are poorly coordinated and disconnected from the Climate Change Task Force and national planning processes.

4. Results

4.1. Overview of adaptive comanagement in Nusa Tenggara Barat

The first objective of this systematic review is to distill the range of studies into a synthesized overview of ACM in Nusa Tenggara to characterize the literature. Fig. 3 presents the publication dates of the studies and demonstrates an upward trend of publications by year. The year 2016 accounts for most of this trend due to the publication of the Special Issue (12) of *Climate Risk Management*, which outlines the results of a four-year project undertaken by a collaboration between CSIRO and the University of Mataram aimed at integrating ACM into rural development planning.

Adaptive comanagement literature incorporates various perspectives of environmental governance and resource management, amalgamating both theory and practice. As such, this review presents the scholarly orientation of these studies by coding the studies and the cases found therein either as theoretical or empirical. In this context, this review characterizes theoretical studies and cases primarily conceptual in its objective and methodologies. Empirical studies and cases are characterized as primarily seeking to produce data and empirical analysis. The term “case” refers to an in-depth focus on a topic or presentation of one or more studies. The review identified 49 cases found within the 24 studies analyzed. Of the 49 cases, 30 (61%) were identified as theoretical and 19 (39%) were identified as empirical. However, most cases presented a combination of conceptual and empirical analysis.

Axial coding was then conducted to unpack the contextual nature of ACM by discerning contextual characteristics. Doing so delineates the scale, scope, resources, and geographical location on which ACM efforts have focused. Table 1 presents a summary of the findings and description of contextual characteristics.

Table 1 demonstrates ACM in Nusa Tenggara Barat is most often engaged (through practice or analysis) with institutions and social-ecological systems on a regional scale. Efforts to either conceptualize, implement, or evaluate ACM focused on communities across both islands of Lombok and Sumbawa as opposed to one island in isolation or one geographic area of one island. ACM inherently aims to build horizontal and vertical links between and across scales. As such, these categorizations merely describe the vertical extent of ACM engagement. Horizontally, the results demonstrate the island of Lombok was the primary site of analysis. Lombok was included in the analysis of 29 of the 49 (59%) cases. All 7 of the cases that analyzed Sumbawa were found in studies that also included analysis of Lombok.

Most ACM cases did not focus on one resource or environmental concern, but rather widened its scope to focus on social-ecological systems more broadly. Of the cases that did focus on one or more resource or environmental concern, agriculture was most common (22%). Of the 11 cases that analyzed agriculture, 5 of them also examined water resources management. Results also demonstrate that 38 of all 49 cases (78%) examined resource use and environmental concern on local scales.

4.2. Themes of adaptive comanagement in NTB

Our second objective sought to identify the most salient thematic components of ACM in Nusa Tenggara Barat. Line-by-line coding of results, discussion, and conclusion sections of the studies was undertaken to extract text passages that

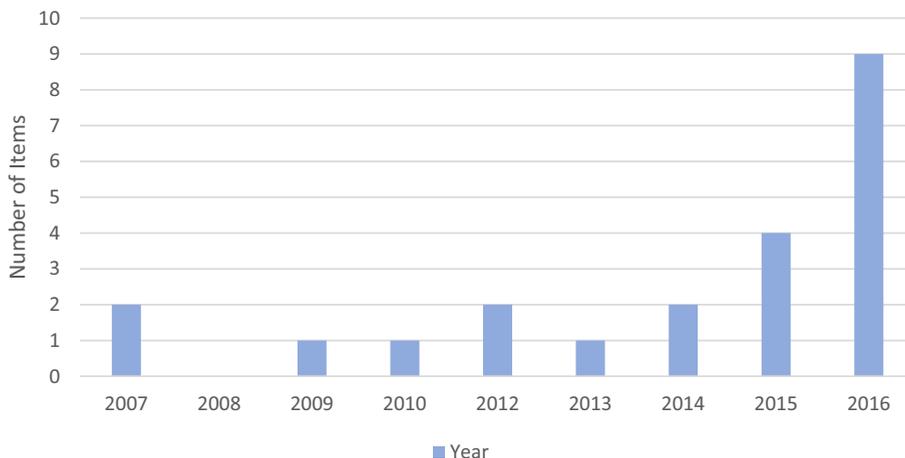


Fig. 3. Adaptive comanagement studies in Nusa Tenggara by publication date.

Table 1
Contextual nature of adaptive comanagement in Nusa Tenggara Barat.

Contextual component		Description	All studies	Cases in primarily theoretical items	Cases in primarily empirical items	Cases in all items
Scale of ACM	Regional	Case examines ACM across NTB (both islands)	13	19	14	33
	Island	Case examines ACM in only one of the two islands	5	4	2	6
	Regency	Case examines ACM in one regency	4	2	2	4
	Local	Case examines ACM in sub-districts or communities	2	6	0	6
Location	NTB	Does not specify where in NTB case is located	9	6	7	13
	Lombok Sumbawa	Case is located in Lombok only Case is located in Sumbawa only	16 7	17 4	12 3	29 7
Type of Resource or Environmental Concern	Water	Management of water bodies or resources	8	7	2	9
	Agriculture	Management of agriculture	9	7	4	11
	Protected Area	Management of a protected area or park	1	1	0	1
	Coastal	Management of coasts and coral reefs	1	1	0	1
	Unspecific	Does not specify or general ecological management	13	21	14	35
Scale of Resource or Environmental Concern	Regional	Resource concerns the region of NTB	4	4	0	4
	Island	Resource concerns only one of the two islands	1	1	0	1
	Regency	Resource concerns one regency	5	4	2	6
	Local	Resource concerns sub-districts or communities	14	22	16	38

explicitly or implicitly identified and recognized key components of ACM. To evaluate the NTB-specific adaptive comanagement literature within the context of the broader ACM literature, the thematic components generated from the systematic review conducted by [Plummer et al. \(2012\)](#) are used with minor modification to the descriptions. Many of these components are intimately related because of the complexity of the social-ecological systems ACM seeks to engage with.

[Table 2](#) presents a description of these components, their various sub-themes, and their prevalence in the studies. [Fig. 4](#) then presents the range and prevalence of these components.

Results show the most salient themes of ACM in NTB are enabling conditions, shared power, knowledge, organizational interactions, trust, and networks. Of these, enabling conditions were the most salient component, appearing in 17 (70%) of studies and 65 passages.

5. Discussion

Several of Nusa Tenggara Barat's physical and social characteristics discussed above proved the province to be a suitable and practical field-site for ACM conceptualization and implementation. Nusa Tenggara Barat presents ACM scholars and practitioners with a unique opportunity to glean valuable lessons broadly applicable to a wide array of contexts. As such, lessons learned may also be broadly applicable to rural communities and the developing world.

5.1. Characterizing contextual nature

As [Table 1](#) reveals, the context of adaptive comanagement in Nusa Tenggara varies widely. Typically, ACM focused on an environmental resource or concern on a local-scale. The steep climate gradients across NTB's geographies resulted in considerable local variation of climate change impacts and projections ([Yasin et al., 2007](#); [Kirono et al., 2016](#); [McGregor et al., 2016](#)). Additionally, marked variation in soil types, livelihoods, and population growth rates resulted in variation of social-ecological systems and adaptive capacities between and within sub-districts ([Skewes et al., 2016](#)).

This heterogeneity is an obstacle to the scaling-out of the conceptualization or implementation of ACM in order to forge vertical links between higher levels of decision-makers (i.e., provincial, regional, national) and horizontal links with wider geographic areas. For example, after a four-year project aimed at building adaptive capacity across various stakeholder levels in the province, [Butler et al. \(2016a\)](#) determined that the considerable social and ecological heterogeneity of the island resulted in contrasting priority strategies between case studies. The authors asserted the feasibility of scaling-out many

Table 2
Themes of adaptive comanagement in Nusa Tenggara Barat.

Thematic component	Description	No. of studies	No. of passages
Bridging organizations	Bridging organizations/institutions are intermediaries (not individuals), and attention in this theme is on the role played by these bodies. Attention is given to how they support interface with other variables (e.g., learning, trust, networks, linkages) and catalyze ACM. Function of “boundary organizations or “brokering organizations are included	7	11
Conflict	Conflict encompasses tensions arising between/among the individuals and organizations in ACM. Sub-themes include: conflict resolution, mechanisms to resolve conflict, opportunities associated with conflicts	4	17
Enabling conditions	Enabling conditions include circumstances central to developing and/or sustaining the ACM process. Sub-themes include: legislation or policy, the role of government, funding, time scales, systematic drivers, uncertainty, complexity, ecological context, and livelihoods	17	65
Incentives	Incentives encompass things that incite, sustain, or truncate ACM. The general notion of incentives is identified as being important to ACM and as unconditional catalyst (both monetary and non-monetary). Additional sub-themes focus on rewards and punishments contingent on specific achievements/ behaviors	5	7
Knowledge	The information/skills/expertise/experiences/worldviews that individuals and organizations bring to ACM and their associated uses and influences are encapsulated in the theme knowledge. Sub-themes include: combination of knowledge, types of knowledge, information forms and functions, communication of knowledge, control of knowledge, and knowledge in relation to other variables	15	47
Leadership	The act of leading or emergence of guiding (by an individual or organization) emerged as the theme leadership	4	9
Learning	Learning broadly concerns how knowledge is gained and employed in relation to ACM. Attention is also given to the influence of the learning process on ACM as well as its interaction with other variables. Other sub-themes include: social learning, experiential learning, monitoring and evaluation, and transformative learning	4	16
Networks	Networks capture the connections (structurally and functionally) between and among the entities. Sub-themes include: the features of networks (e.g., cross-scale, multi-level,) the type of networks (e.g., formal, informal), and relationship to other variables (e.g., social capital, learning, knowledge)	11	31
Organizational interactions	Organizational interactions consider links between and among organizations (formal and informal). Sub-themes include: nature of these links (horizontal and vertical), the extent to which they cross scales and levels, the fit with ecosystems, and their consequences (e.g., enhance fit)	12	34
Shared Power	Shared power is a foundational premise of ACM and often considered a structural element. The theme is often employed in a general sense to convey the collective ability to influence or exert authority. Sub-themes include: empowerment, devolution of power (decentralization), power asymmetries, marginalization, and resource rights	12	50
Shared responsibility	Shared responsibility refers to the collective sharing of obligations for a resource or environmental consideration. Incorporation of rights and transfer of responsibility are common consideration	7	20
Trust	Trust focuses on the relationship between and among people. Trust is considered as a key influence on the success or failure of ACM. It is examined within case studies and highlighted as a critical link in building cross-scale and cross-level links	9	31

incremental strategies targeting local production systems is limited as a result. This, in turn, has further implications for the required resources, time frames, and funding necessary for effective planning and implementation (Butler et al., 2016a).

Future research could focus on examining the factors that facilitate or impede effective scaling-out of adaptive comanagement strategies, both vertically across decision-making levels and horizontally across geographic areas. Heterogeneity greatly exacerbates the complexity of forging links by introducing varied and oftentimes competing interests, power dynamics, norms, etc. Although many studies have examined the factors contributing to the success or failure of adaptive comanagement (Lee, 1999; Munaretto and Huitema, 2012; Plummer et al., 2012), few discuss how heterogeneity influences the ability to successfully forge vertical links with higher levels of decision-makers and or horizontal links with wider geographic areas. In fact, the systematic review of the broader ACM literature undertaken by Plummer et al. (2012), reveal only one passage out of the 196 passages analyzed discussed “lack of homogeneity among resource systems and users” as a factor contributing to failures of adaptive comanagement. Such research could, for example, compare ACM attempts to forge vertical links or horizontal links in a heterogeneous context with a contrasting control case of ACM link-building in homogeneous contexts.

Although studies focused on local-scale resources and concerns, many cases examined ACM and lessons learned on a regional-scale or island-scale, despite the obstacle of NTB’s heterogeneity. Of the 38 cases that focused on local-scale resources and concerns, 27 cases extrapolated to examine ACM on a regional-scale and 4 cases examined ACM on an island-scale. Although more than half of these cases were examined in cross-case comparisons, unpacking these contextual nuances reveal conceptual gaps in the literature as local-scale cases are extrapolated to induce lessons learned for higher scales. This extrapolation risks potentially over-generalizing lessons learned and misguidedly applying adaptation strategies to contexts in which they may not be suitable, potentially leading to impractical, ineffective, and or maladaptive implementation. For instance, Sjah and Baldwin (2014) relied on investigations of eighteen villages in Central Lombok as a basis to develop strategies of institutional reform of water user associations across the island of Lombok, despite variation in local practices, processes, resource access, and resource intensity between and within Central, North, West, and East Lombok.

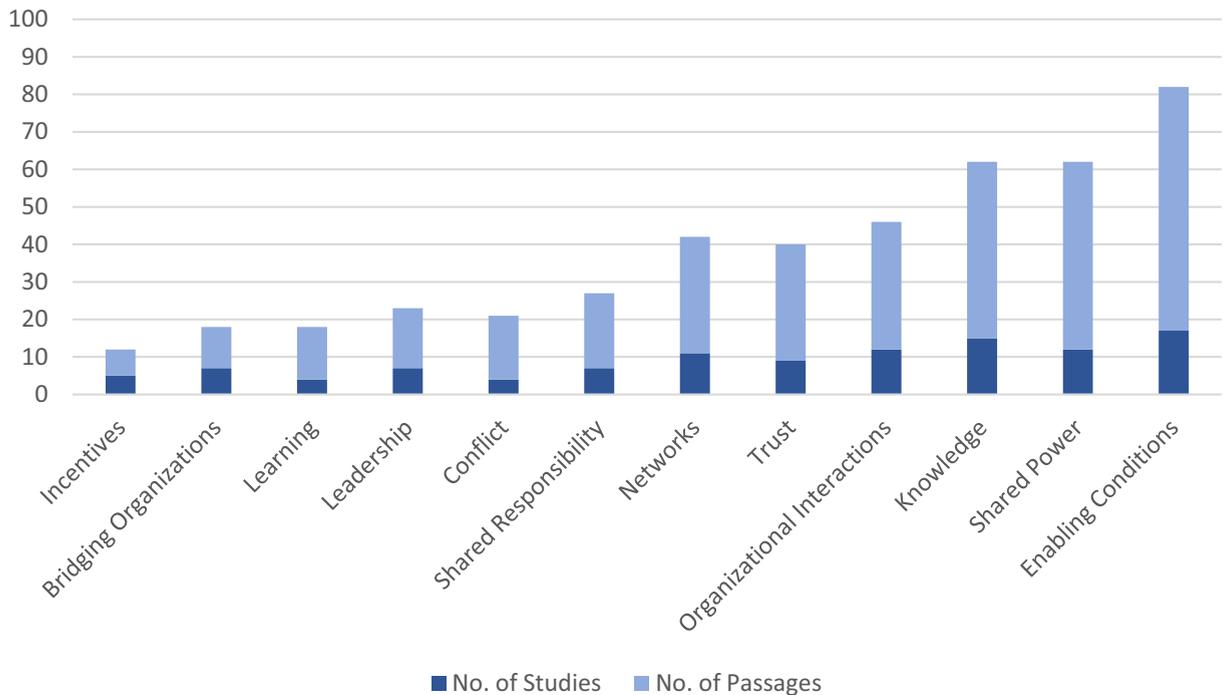


Fig. 4. Salience of adaptive comanagement thematic components in Nusa Tenggara Barat.

Furthermore, the results reveal a heavily Lombok-centric focus, with only 7 of 49 (14%) cases analyzing the neighboring island of Sumbawa. Presumably, this focus is a result Lombok's high proportion and concentration of the province's total population. A more comprehensive understanding of ACM in Nusa Tenggara Barat requires more ACM research in Sumbawa.

5.2. Salient components and emergent themes

The most prevalent thematic components of adaptive comanagement in Nusa Tenggara Barat include enabling conditions, shared power, knowledge, organizational interactions, trust, and networks, in that order. Each of these components was mentioned in over 9 studies and 31 passages. In comparison, the systematic review undertaken by [Plummer et al. \(2012\)](#) yielded the themes of learning, knowledge, networks, organizational interactions, shared power, and trust to be the most salient.

The premise of adaptive comanagement is learning, specifically shared learning across social and ecological scales to accommodate change. Thus, the notable contrast between the relative absence of learning in this systematic review and the salience of learning in the broader systematic review of ACM merits a discussion.

The studies that do discuss learning give an indication of the difficulties of initiating and maintaining extended learning processes aimed at enhancing adaptive capacities ([Butler et al., 2014, 2016a; Wise et al., 2016](#)). Intuitively, Lombok, an island characterized by weak adaptive capacity and low knowledge base, seems ripe for immediate learning opportunities. However, attempts to structure social learning processes resulted in strategies and actions aimed at addressing proximate human needs. Instead of stimulating extended and transformative learning processes to address systemic causes of vulnerability, learning processes resulted in incremental enhancements of adaptive capacities. In other words, stakeholders gave precedence to short-term actions over long-term strategies. This is seen in the effort by [Wise et al. \(2016\)](#) to develop and execute planning workshops using a multi-level participatory approach aimed at encouraging social learning and cross-scale collaboration. Although stakeholders in these planning workshops recognized systemic challenges, they were unwilling to challenge them due to weak capacity, opting instead for incremental strategies aimed at addressing immediate livelihood needs ([Wise et al., 2016](#)). Additionally, although workshops and participatory processes were designed to encourage double and triple-loop learning to identify and address systemic challenges, studies found that insufficient time was provided for stakeholder reflection to develop transformative objectives that went beyond immediate challenges and incremental actions ([Butler et al., 2016a](#)).

The prioritization of addressing immediate human and livelihoods challenges over underlying systemic challenges, particularly in developing countries, is already well understood ([Wise et al., 2016](#)). However, future ACM research could examine how to structure planning processes to overcome this prioritization. By encouraging double and triple-loop learning processes among stakeholders over extended time-frames, ACM may effectively contextualize the immediate needs in

relation to their systemic causes, in effect simultaneously building incremental and transformative capacities to address them. To do so, this double and triple-loop learning must be informed by an understanding of the systemic causes, the leverage points necessary to meaningfully address them, and the appropriate actors and channels in which to engage these leverage points (Abson et al., 2016). Such insight would be valuable in ACM planning and implementation in developing contexts where immediate livelihood and human challenges are pervasive.

5.2.1. Enabling conditions

ACM outcomes in Nusa Tenggara Barat are closely tied to the highly complex and dynamic structural conditions in which they operate (Suroso et al., 2009). Butler et al. (2014) revealed 20 systemic drivers of community vulnerability of which climate variability and change are only two. Climate change interacts with the other systemic drivers, exacerbating land, water, and food insecurity (UN WFP, 2013). Furthermore, this vulnerability is reinforced by chronic corruption and power dynamics among and between actors (Fachry et al., 2011; Sjah and Klock, 2011; Butler et al., 2014).

In NTB, adaptation and development strategies made and pursued by the central and provincial governments are often top-down and heavy-handed (Astawa, 2004; Sjah and Klock, 2011; Sjah and Baldwin, 2014; Butler et al., 2014). As such, integrating ACM strategies focused on capacity-building across scales has been difficult. Many studies have identified the ongoing process of decentralization as an opportunity to reverse top-down obstacles to ACM integration by building lower-level capacity through bottom-up approaches (Astawa, 2004; Sjah and Klock, 2011; Sjah and Baldwin, 2014; Butler et al., 2014; Wise et al., 2016). However, the high degree of institutional flux and system complexity caused by decentralization produced uncertainty, poor coordination, and oftentimes contradictory adaptation and development planning (Sjah and Baldwin, 2014; Butler et al., 2016a). This is exemplified by the misperceptions among agencies and farmers surrounding administration of water user associations in Lombok. Three different government agencies are tasked with various aspects of water user association development and guidance. Rather than building lower-level capacities through bottom-up approaches, the dissemination of authority results in “inter-agency turf wars” with regards to authority of irrigation management, water use, and irrigated agricultural matters (Klock, 2007).

These conditions, reinforced by systemic drivers, create locked-in system path-dependencies and make productive change through ACM difficult. This necessitates long-term planning and extended time-frames for effective ACM implementation (Butler et al., 2014, 2016b; Wise et al., 2016). As discussed above, attempts at ACM thus far, have yielded only incremental enhancements in adaptive capacity because of the precedence of immediate challenges over systemic challenges. However, these attempts also revealed stakeholder awareness of systemic causes of vulnerability, indicating longer time frames were needed to move beyond immediate needs and produce transformative long-term objectives and actions. Such an example demonstrates the need for ACM projects to ensure long-term planning and extended time-frames be accompanied by long-term funding to effectively produce sustained implementation. Extended time-frames and long-term funding however, are not sufficient if not also accompanied by the double and triple-loop learning, understanding of leverage points, and engagement with appropriate actors and channels of actions discussed above.

The broader systematic review of ACM undertaken by Plummer et al. (2012) confirms the need for research on long-term vision, planning, and funding. Of the 196 passages analyzed in the review, one discussed funding as a factor of success, three discussed long-term commitment as a potential factor of success, two discussed short-term outlook as a factor or potential factor of failure, and three discussed insufficient resources as a potential factor of failure of ACM (Plummer et al., 2012).

5.2.2. Shared power and trust

Decentralization disseminated power and influence relating to official development and adaptation planning among district-level politicians (Fachry et al., 2011; Butler et al., 2016a). Rural communities and local-level stakeholders below these district-levels have often been marginalized from the decision-making process, resulting in development and adaptation projects that typically benefit elites (Butler et al., 2014). This is seen in the emphasis placed on potentially maladaptive infrastructure projects by higher-level officials and decision-makers (Sjah and Klock, 2007). Infrastructure is essential to building adaptive capacity in Lombok. However, infrastructure projects often produce high levels of political visibility and rent-seeking opportunities, but little incentive to carry out maintenance (Bruns, 2001).

This corruption and marginalization have created considerable tension between formal and informal leaders (Astawa, 2004; Fachry et al., 2011; Butler et al., 2014). Power dynamics and asymmetries obstruct effective ACM by impeding capacity-building across scales. Many studies underscored the need to more effectively engage with disadvantaged communities and stakeholders by expanding participation and adequate representation in decision-making and official planning processes. Many posit such an approach serves to mitigate power dynamics, generate a more robust knowledge culture, empower communities, and improve coordination and efficient implementation of ACM (Sjah and Baldwin, 2014; Priyono et al., 2015; Bohensky et al., 2016; Skewes et al., 2016). However, Butler et al. (2016a) discovered the potential for such interventions to insufficiently engage with the appropriate political actors by not adequately involving them in project planning. This corroborates findings by Plummer et al. (2012), which identified conflict of interests and power asymmetries among those involved to be the two most salient factors contributing to failures of ACM in the literature.

Thus, further research should aim to strike a balance between mitigating power dynamics between stakeholders, including adequate participation and representation of lower-level stakeholders in decision-making and planning processes, and effectively engaging with appropriate political actors. In other words, future research must work to build capacity across and between scales to overcome power asymmetries. Specifically, future ACM research could examine the effect of building

and supporting coalitions of both key decision-makers and underrepresented stakeholders around shared visions and interest. This could empower typically marginalized stakeholders, and in effect, generate a more robust knowledge base and improve implementation. Additionally, traditional decision-making processes (discussed below) that are understood and respected across scales of decision-makers could be leveraged to provide for adequate participation of all levels. Such research can provide the ACM literature with insight into how to dismantle the obstacle of power asymmetries and encourage collaborative learning and targeted capacity enhancement, particularly in typically marginalized communities with weak adaptive capacity. These findings would prove valuable to ACM practitioners in characterized by high social stratification, such as those often found in Indonesia and across Asia.

5.2.3. Knowledge

A frequently discussed benefit of expanding the role of local stakeholders' in decision-making and planning is the generation of a robust knowledge culture that is more fine-scale and therefore more practical for ACM planning (Sjah and Baldwin, 2014; Priyono et al., 2015; Maharani and Kabir, 2015; Skewes et al., 2016; Bohensky et al., 2016). Stakeholders have distinct knowledge cultures that influence the identification of proximate and systemic causes of vulnerability, as well as subsequent ACM strategies (Leach et al., 2010). Furthermore, stakeholder knowledge and local expertise can be drawn upon to fill data and informational gaps (Butler et al., 2016a). This is particularly pertinent in developing contexts, which often suffer from generally poor quality and quantity of information and empirical data to inform decision makers on appropriate adaptation strategies (Liu et al., 2016; Rochester et al., 2016). The results of this review confirmed this finding. Most the studies and cases were primarily conceptual, lacking important empirical information.

Conversely, there is a need for more comprehensive information flows from scientists and experts to local-levels (Sjah and Baldwin, 2014; Skewes et al., 2016). Due to the tensions between formal and informal leaders created by corruption and power asymmetries, the presentation of scientific information on complex issues such as climate change adaptation is often lacking credibility in the eyes of local stakeholders (Butler et al., 2014). Furthermore, power asymmetries strongly influence stakeholder perspectives of vulnerability and appropriate adaptation and development strategies because of asymmetrical access to information flows among stakeholders. (Bohensky et al., 2016).

The linking of formal science and local or indigenous knowledge cultures is already a widely-discussed theme in adaptive comanagement literature (Plummer and Armitage, 2010; Plummer et al., 2012, 2013). However, this review demonstrates the need for ACM literature to address how to better integrate such knowledge cultures with the specific aims of generating more robust and practical knowledge cultures, mitigating power asymmetries, and filling knowledge gaps, particularly in contexts where essential empirical information is absent. Plummer et al. (2012) confirm this need, as only 4 of 196 passages discussed sharing of information and knowledge as a factor contributing to the success of ACM and only 3 passages discussed deficiencies in knowledge and information as a potential factor of failure (Plummer et al., 2012).

5.2.4. Organizational interactions

Forging horizontal and vertical links for increased collaboration, cooperation, and integration across multiple scales is a central objective of adaptive comanagement. The four preceding thematic components necessitate improved organizational interactions in order to forge such links. Enabling conditions such as heavy-handed top-down adaptation approaches and decentralization have resulted in increased complexity and poorly coordinated adaptation and development planning (Sjah and Baldwin, 2014; Butler et al., 2016a). Power dynamics have increased tensions between stakeholders, impeding productive collaboration and cooperation (Astawa, 2004; Fachry et al., 2011; Butler et al., 2014). Knowledge and informational gaps necessitate the integration of diverse knowledge cultures (Priyono et al., 2015; Butler et al., 2016a).

As demonstrated by the systematic review undertaken by Plummer et al. (2012), organizational interactions, conflict of interests of those involved, and participation of all relevant stakeholders in management are already widely discussed in ACM literature. However, rarely discussed is how traditional local practices can serve to improve or exacerbate these organizational interactions.

Several studies in this systematic review identified traditional local practices in NTB that may prove or have already been proven to be effective mechanisms of promoting collaboration, compromise, deliberation and cooperation between stakeholders. These practices include customary laws derived from traditional knowledge known as “*awig-awig*,” a traditional consensus-based decision-making and conflict-resolution process known as “*musyawarah*,” a process of community action aimed at producing collective benefits known as “*gotong royong*,” and a local multi-stakeholder development planning process that integrates top-down and bottom-up approaches known as “*musrenbang*” (Fachry et al., 2011; Sjah and Klock, 2011; Sjah and Baldwin, 2014; Priyono et al., 2015; Butler et al., 2016b). These local practices are widely-known by stakeholders across scales and recognized by government officials as legitimate. As such, they present potentially effective points of entry of ACM planning.

ACM research would benefit from an examination of the mechanisms by which traditional practices function at local-levels to promote collaboration, compromise, and cooperation. This is particularly valuable in developing world contexts where communities are often rural and adhere to entrenched traditional practices and customs. Future research could also examine how these practices, which are recognized across levels, could be extended vertically to effectively engage with decision-makers on different scales.

6. Conclusion

This review provides a systematic narrative review of efforts undertaken thus far to conceptualize and implement adaptive comanagement in Nusa Tenggara Barat province, Indonesia. The objectives of doing so were to characterize the literature, discern the emerging thematic components of the literature, and identify knowledge gaps and areas for further research.

Characterizing the contextual nature underscores the marked heterogeneity of Nusa Tenggara Barat's physical and social geographies. Further analysis revealed that this impedes the ability of both scholars and practitioners to scale out the conceptualization and implementation of adaptive comanagement vertically across levels of decision-makers and horizontally across geographic areas. This, in turn, exacerbates the established challenges of securing sufficient resources and funding to sustain effective adaptive comanagement. Although the factors contributing to the success or failure of adaptive comanagement is already widely discussed in the literature, research on how heterogeneity or homogeneity influence the success or failure of ACM is severely lacking. Understanding these factors is essential to ACM's objective to forge vertical and horizontal links for shared learning between actors across scales.

Further unpacking the literature also revealed ACM cases typically focused on local-level resource management. However, lessons extrapolated from these local-level cases are often presented as lessons for the province more broadly. Such extrapolations risk potentially over-generalizing lessons learned and misguidedly applying adaptation strategies to contexts in which they may not be suitable, potentially leading to impractical, ineffective, and or maladaptive implementation.

Enabling conditions, knowledge, shared power, trust, and organizational interactions were identified as the most salient thematic components of the literature thus far. Although this largely mirrors the thematic components found by [Plummer et al. \(2012\)](#) and their systematic review, notably absent from this list is the thematic component of learning, a fundamental component to adaptive comanagement. An analysis of the studies that did address learning as a component of adaptive comanagement in NTB indicates that the challenge of encouraging learning processes in NTB arose from the prioritization of addressing immediate human and livelihood challenges over underlying systemic challenges. This prioritization is discussed and understood in broader ACM literature, particularly in developing contexts such as NTB. However, there is a need for research to examine ways to structure planning processes that encourage double and triple-loop learning that effectively contextualize the immediate challenges in relation to systemic causes. This, in effect, simultaneously builds incremental and transformational adaptive capacities to address them. As this prioritization is frequently seen in developing countries and contexts, this research would prove valuable for understanding how to effectively achieve the ACM objective of enhancing transformational capacity in communities with weak adaptive capacity.

ACM outcomes in NTB are significantly determined by the enabling conditions of decentralization, systemic and proximate drivers of vulnerability, and top-down government development and adaptation approaches. Adaptation and development strategies made and pursued by the central and provincial governments are often top-down and heavy-handed. The process of decentralization that disseminated power among stakeholders was originally seen to be an opportunity to reverse such top-down approaches by fostering bottom-up local-level participation in planning and implementation. However, it was found that decentralization created a situation of considerable institutional flux and system complexity that resulted in uncertainty, poor coordination, and even contradictory adaptation and development planning. These conditions made transformative change difficult and reinforced the need to address immediate human and livelihood needs. Such conditions necessitate long-term planning, extended time-frames, and sustainable funding in order to maintain extended adaptive comanagement strategies that address these underlying systemic challenges. Although already somewhat intuitive, broader ACM literature rarely discusses the effect of extended vision planning and funding duration on the success or failure of adaptive comanagement implementation.

Widely discussed in the broader ACM literature is how conflicts of interests and power asymmetries influence ACM outcomes ([Plummer et al., 2012](#)). This review corroborates this, revealing the process of decentralization served to undermine trust and create tension between and among various levels of decision-makers. Furthermore, local-level stakeholders are often marginalized from the planning process and are not provided adequate participation. This obstructs effective ACM by impeding capacity-building across scales. Many studies underscored the need to more effectively engage with disadvantaged communities and stakeholders by expanding participation and adequate representation in decision-making and official planning processes. However, it was also found that focusing too narrowly on local-level participation risks alienating the key movers and decision-makers needed to bring about transformative change. Thus, future ACM research should aim to strike a balance between mitigating power dynamics between stakeholders, including adequate participation and representation of lower-level stakeholders in decision-making, and effectively engaging with appropriate political actors. Such research could provide valuable insight for adaptation comanagement in socially stratified societies and communities, such as those often found across Indonesia and Asia more broadly.

Engagement with all relevant actors also produces the benefit of incorporation of indigenous knowledge. This empowers typically marginalized stakeholders, generates a more robust knowledge base, and improves the practical implementation of ACM strategies. Filling informational and knowledge gaps are particularly important in developing contexts, such as NTB, where the quality and quantity of data necessary to make informed decisions are often severely lacking. Although the linking of formal science and local or indigenous knowledge cultures is discussed in adaptive comanagement literature, this review

revealed the need for ACM literature to address how to better integrate such knowledge cultures with the specific aims of generating more robust and practical knowledge cultures, mitigating power asymmetries, and filling knowledge gaps.

Finally, poor cooperation and collaboration between and among stakeholders is another major obstacle to effective adaptive comanagement. This review suggests traditional and customary practices and mechanisms of community interaction present an entry point for more effective cooperation and integration because these practices are already well established, understood, and respected by many actors across levels. This is particularly valuable in developing world contexts where communities are often rural and adhere to deeply-embedded traditional practices and customs. Further examinations could identify the collaborative functions of these practices and seek to effectively extend them across scales.

This review can serve as a key source of evidence-based information from which adaptive comanagement scholars, policy-makers, and practitioners can draw to build the adaptive capacity of communities such as those found in Nusa Tenggara Barat.

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