The Political Ecology of Spatial Development Initiatives, Indonesia

Landscape in Lombok, Indonesia, by James Langston

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Thesis for the Degree of Doctor of Philosophy
(Agriculture, Environmental and Related Studies)
May, 2019

The College of Science and Engineering
James Cook University

Acknowledgements

My research is inspired by the time I've spent with local communities across the tropics – in Asia, Africa, and the Americas. But I first thank my primary advisors, Professors Jeff Sayer and Intu Boedhihartono, for the unimagined opportunities granted to me, making this research possible. Early time spent with them in their Development Practice Program at James Cook University instilled a philosophically broad-based commitment to research in me. The tenets of that philosophy are taking empathetic, integrated, improvisational (in a musical, jazz sense), experiential, and anti-fragile approach to learning and life. I cannot thank them enough for their inspiration, guidance, and the opportunities they provided. The expansive network of friends and colleagues built over the time of this research, was made possible by my advisors. All of them have been invaluable to this research. I am very thankful to all of my colleagues and friends who have contributed, enabled, or otherwise fostered our team's ability to conduct research in our problem and solution oriented, action-oriented, and societally embedded way.

Dr. Chris Margules deserves special thanks for his unwavering support, commitment, and pragmatic clarity during times of confusion and ambiguity. Professor Terry Sunderland has provided professional and collegial guidance, for which I am also immensely thankful. I thank Professor Paul Dirks for his invaluable guidance on how to approach the research, and how to navigate university structures and processes. I am now good friends with all of my advisors and would not have done it any other way.

I am grateful to the College of Science and Engineering at James Cook University for providing the assistance and opportunities through tumultuous restructures at JCU. Janet Catterall, Leanne Shillitoe, and Teresa Carrette have been invaluable support in helping me navigate the administrative pathways and reach the right milestones at the right time.

Much of my research was kindled by the drive, diversity, and social stimuli of seven cohorts of the Masters of Development Practice Program at JCU (2011-2017). I am privileged to have been able to get to know them all, and to be a part of their co-learning experience. Without them, I would not have the broad-based understanding of sustainability issues, and the emotional intelligence and empathy I continue to strive for. These thanks are also extended to the PhDs in

Statement on the Contribution of Others & Authors Consent to Include Publications as Part of PhD Thesis			
Thesis Title:	**The Political Ecology of Spatial Development Initiatives, Indonesia**		
Name of Candidate:	**James Douglas Langston**		
Chapter number and title	Details of publication(s) on which chapter is based:	Nature and extent of the intellectual input of each author, including the candidate	I confirm the candidate's contribution to this paper and consent to the inclusion of the paper in this thesis
Chapter No. 1: **Discourses mapped by Q-method shows governance constraints motivate landscape approaches in Indonesia**	Chapter is the original publication Langston, J. D., McIntyre, R., Falconer, K., Sunderland, T., van Noordwijk, M., & Boedhihartono, A. K. (2019). Discourses mapped by Q-method show governance constraints motivate landscape approaches in Indonesia. *Plos One, 14*(1), e0211221.	James Douglas Langston is the senior author responsible for the manuscript. Meine Van Noordwijk contributed to conceptual background and direction for the manuscript. Rowan McIntyre and Keith Falconer contributed to data collection and analysis. Terry Sunderland and Agni Klintuni Boedhihartono Contributed to manuscript writing and conceptual direction for the manuscript.	Meine van Noordwijk Signature: Rowan McIntyre Signature: Terry Sunderland Signature: Agni Klintuni Boedhihartono Signature:
Chapter No. 2: **Comparative development benefits from small and large scale mines in North Sulawesi, Indonesia**	Chapter is the original publication Langston, J. D., Lubis, M. I., Sayer, J. A., Margules, C., Boedhihartono, A. K., & Dirks, P. H. G. M. (2015). Comparative development benefits from small and large scale mines in North Sulawesi, Indonesia. *The Extractive Industries and Society, 2*, 434-444.	James Douglas Langston conceived and designed the study, Muhammad I. Lubis assisted in the design of the study and assisted in data collection and analysis, Jeffrey Sayer provided conceptual direction and text edits, Chris Margules helped with the manuscript edits, Agni Klintuni Boedhihartono assisted in the research design, Paul H.G.M. Dirks assisted in the conceptual direction and manuscript edits.	Muhammad I. Lubis Signature: Jeffrey Sayer Signature: Chris Margules Signature: Agni Klintuni Boedhihartono Signature:

			Paul H.G.M. Dirks Signature:
Chapter No. 3: **Estate Crops More Attractive than Community Forests in West Kalimantan, Indonesia**	Chapter is the original publication Langston, J., Riggs, R., Sururi, Y., Sunderland, T., & Munawir, M. (2017). Estate Crops More Attractive than Community Forests in West Kalimantan, Indonesia. Land, 6(1), 12. doi:10.3390/land6010012	James Douglas Langston conceived and designed the study; James Douglas Langston and Yazid Sururi performed the field study; Muhammad Munawir helped facilitate field study and contributed to the biophysical and social data; James Douglas Langston, Rebecca Anne Riggs and Yazid Sururi analyzed the data; Terry Sunderland provided insightful edits and ideas to enrich the context, results, and discussion. James Douglas Langston and Rebecca Anne Riggs drafted the original paper and Yazid Sururi, Muhammad Munawir, Terry Sunderland contributed edits and comments to subsequent drafts.	Yazid Sururi Signature: Muhammad Munawir Signature: Rebecca Anne Riggs Signature: Terry Sunderland Signature:
Chapter No. 4: **Governance Challenges in an Eastern Indonesian Forest Landscape**	Chapter is the original publication Riggs, R. A., Langston, J. D., Margules, C., Boedhihartono, A. K., Lim, H. S., Sari, D. A., Sururi, Y., Sayer, J. (2018). Governance Challenges in an Eastern Indonesian Forest Landscape. Sustainability, 10(1), 169.	Yazid Sururi, Han She Lim and Agni Klintuni Boedhihartono facilitated field workshops; Chris Margules, Dwi Amalia Sari, Jeffrey Sayer, Rebecca Anne Riggs and James Douglas Langston analyzed the data; Rebecca Anne Riggs and James Douglas Langston. wrote the paper. Han She Lim, Agni Klintuni Boedhihartono, Chris Margules, Dwi Amalia Sari, and Jeffrey Sayer contributed edits and comments to subsequent drafts.	Yazid Sururi Signature: Han She Lim Signature: Agni Klintuni Boedhihartono Signature: Chris Margules

			Signature:
			Dwi Amalia Sari Signature:
			Jeffrey Sayer Signature:
			Rebecca Anne Riggs Signature:
Chapter No. 5: **Conservation and development pressures intensify on one of Indonesia's least development large islands, Seram**	Chapter is a paper submitted for consideration as a publication to the Singapore Journal of Tropical Geography Langston, J. D., Riggs, R. A., Boedhihartono, A. K., Kastanya, A., & Sayer, J. (Submitted). Conservation and development pressures intensify on one of Indonesia's least developed large islands, Seram. *Singapore Journal of Tropical Geography*.	James Douglas Langston wrote the manuscript, conceived and designed the study. Rebecca Anne Riggs assisted with the design and manuscript edits Agni Klintuni Boedhihartono assisted with fieldwork and conceptual design. Agus Kastanya assisted with data collection and interpretation. Jeffrey Sayer provided manuscript edits and conceptual design.	Rebecca Anne Riggs Signature: Intu Boedhihartono Signature: Agus Kastanya Signature: Jeffrey Saye Signature:
Chapter No. 6: **Science embedded in locally managed forest landscapes to co-generate knowledge and policy**	Chapter is the original publication Langston, J. D., Riggs, R. A., Kastanya, A., Sayer, J., Margules, C., & Boedhihartono, A. K. (2019). Science Embedded in Local Forest Landscape Management Improves Benefit Flows to Society. *Frontiers in Forests and*	James Douglas Langston wrote the manuscript and conceived of the paper. Rebecca Anne Riggs, Jeffrey Sayer, Chris Margules, and Agni Klintuni Boedhihartono all contributed to the conceptual framing and text edits. Jeffrey Sayer and Agus Kastanya provided inputs to the case studies in the discussion.	Rebecca Anne Riggs Signature: Jeffrey Sayer Signature: Chris Margules

	Global Change, 2(3). doi:10.3389/ffgc.2019.00003		Signature: Agni Klintuni Boedhihartono Signature: Agus Kastanya Signature:

Abstract

Indonesia is a socially and environmentally diverse nation where people make difficult decisions affecting the sustainability and inclusivity of their development. It contains the world's fourth largest and still rapidly growing population, who are vigorously pursuing increased economic well-being. Indonesia also contains, arguably, the worlds' most biodiverse ecosystems. Institutional complexity is high. Rapidly changing legislation and shifting hierarchies of control have beset the stewardship of natural, economic, and social assets with difficulties. Indonesia's development threats and opportunities, alongside its rich but degrading natural resources present governance challenges, the lessons of which have relevance and implications far beyond Indonesia's borders.

My thesis explores the lessons learned from landscapes in Indonesia, where the difficult decisions over resource-use allocations unfold. Using place-based, sustainability science, and a transdisciplinary research approach, I diagnose the social, economic, environmental, and political change underway in landscapes on four islands. These islands span Indonesia's comparatively less developed east, to the more developed west. Landscapes are the unit of analysis due to evidence that they are the most manageable scale to understand and 'enter' systems. The landscapes examined in thesis are recipients of large investments into extractive industries, agriculture, and other spatial development initiatives. I examine these drivers of change in different contexts, including estate crops, gold-mines, infrastructure, and decentralized governance.

The thesis addresses three overarching questions, (1) what are leverage points in landscapes for interventions that lead to long-term sustainable development outcomes? (2) What are the impacts of spatial development initiatives on livelihoods and the environment within a landscape? (3) How might research better support co-learning to improve processes and outcomes of landscape change. I collaboratively frame the issues and potential solutions with local people affecting and affected by decisions over resource use and allocation. I experiment with a range of participatory qualitative and quantitative methods including Q Methodology, visualization techniques, theory of change, interviews, and actor network analysis.

My results show that governance is the main constraint to sustainable and inclusive development in landscapes. Narratives that shape governance in landscapes emerge from politically diverse vantage points. Science to enhance sustainability and inclusivity must

understand these political vantage points and begin to co-generate narratives with the full range of decision-makers in landscapes. Landscape-level network analysis can help identify where knowledge co-generation and integration is opportune and can be more influential. Clear and agreed theories of change should emphasize the need to shift institutional arrangements so that they are more conducive to inclusive and sustainable development.

The key lesson from this research is that local governance arrangements evolve to meet the expectations of people in their own contexts, which may be counter-intuitive to external researchers who have preconceptions of what constitutes good, sustainable, and inclusive development. But Indonesia's governance systems face the same adaptation challenges observed globally, where economic and infrastructural developments outpace social adaption rates. Organizations that wish to improve decision-making processes toward enhanced sustainability and inclusivity should seek opportunities to more strategically leverage change. Efforts should be made to bridge gaps between traditional and State management systems. This requires diagnosing the entire social-political-economic-ecological system. To assist, scientists and academia must put more emphasis on the cogeneration and integration of knowledge across disciplinary boundaries, into the pre-existing actor-networks that shape landscapes. Lessons from Indonesia contribute insights for broader global sustainable development solutions.

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Introduction

Threats to nature, rising socio-political inequality, and lingering poverty are entwined crises faced by contemporary societies. These crises are 'wicked problems' in the sense that they are complex, involve many different actors at different scales, and effective solutions are elusive (Balint et al., 2011). Policy-makers, management authorities, and scientific communities frame the problems thematically in terms of climate and land use change, biodiversity conservation, energy demands, food security, well-being, health, and water provisions (Lu et al., 2015). Social, economic, and environmental factors underpin the issues and they occur along continua of temporal and spatial scales (Gunderson, 2001). My thesis aims to contribute to the understanding of these relationships and improve their governance and management for more sustainable development.

Numerous attempts at global levels to reach consensus over 'desirable' goals for development and sustainability has resulted in incoherence, disagreements and inconsistencies (Boedhihartono et al., 2018, Holden et al., 2017). This is partially due to the inherent irreconcilable trade-offs that occur when optimizing some assets against others (McShane et al., 2011, Campbell et al., 2010). It is also due to the political economy of different modes of development – what constitutes the desirable rightful asset ownership and the associated distribution of benefit flows (Brockhaus and Wong, 2017, Barr and Sayer, 2012, Adger et al., 2005, Samset, 2002). Yet, the Sustainable Development Goals (SDGs) were adopted by the United Nations and unites the signatory states in a mission to enhance development for all. The goals are meant to incorporate the complexity of globalized, contemporary societal problems. But, in effect, they are a set of social, environmental, and economically interrelated development targets to be met by sovereign states, in ways that they see fit (Bowen et al., 2017).

The SDGs are meant to bring clarity to Agenda 2030, the overarching mission for a better future for the planet, people, peace, partnership and prosperity. The architects of the SDGs are concerned with achieving inter and intra generational equity and well-being across state lines. Goal 16 – peace, justice, and strong institutions – is an acknowledgment of how important governance is for achieving desirable development outcomes. But the vague targets allow for constructive ambiguity, leading to varied approaches among political powers (Biermann et al.,

2017). Global development discourses, in which the SDGs are embedded, are disconnected from many local realities (Adger et al., 2001, Brown, 2015). SDGs themselves have been criticized for logical contradictions and for not dealing with tradeoffs (Holden et al., 2017, Stafford-Smith et al., 2017). Furthermore, global sustainability targets that have been framed by the scientific community, notably the planetary boundaries concept (Rockström et al., 2009), face impediments from conflicting issue-concerns at different scales, vertically and horizontally. Governance instruments currently in place are not sufficiently integrated and fit for purpose (Brown, 2017, Sari et al., 2019). Our governing organizations, which sit at different scales (governments, civil society groups, and the private sector) make decisions based on narratives that are not held by others and they too frequently intervene using assumptions that are not based on context-specific evidence (Pawson, 2006). As such, governance – the institutional processes by which decisions are made and implemented[1], leads to interventions that are not effective or result in unanticipated consequences.

Ultimately, sustainable development is about managing the balance of conservation and development benefits – it is "a problem that involves balancing multiple objectives, the equitable inclusion of all relevant stakeholders, dealing with power and gender asymmetries, adaptive management based on participatory outcome monitoring, and moving beyond existing administrative, jurisdictional, and sectorial silos" (Ros-Tonen et al., 2018). Many of societies' institutions are too rigid and narrow to adapt their strategies for effective, locally suitable policy interventions (Fukuda-Parr and McNeill, 2015). Our fallible institutions risk leaving marginal and disadvantaged groups in poverty and at a higher risk of conflict, and this decreases the likelihood of good environmental stewardship[2]. To avoid this problem, strong operational methods are needed and this requires scientific communities to develop effective strategies for implementation and metrics for measuring success or failure (Lu et al., 2015, Opdam, 2018). There is a suite of approaches and development models gaining traction, but these need synthesizing, and this research is meant to contribute to that synthesis.

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[1] Definition of governance adapted from Kaufman et al., 2009; UN Committee of Experts on Public Administration, 2006; and the World Bank, 2017.
[2] For further discussions about how rising inequality risks conflict and how environment must be secured through equitable economic growth see Mishra, P. (2017), Pinker, S. (2018), Ridley, M. & Ganser, L. (2010), Rosling, H., Rosling ,O. & Rönnlund, A.R. (2018)

Indonesia contains the world's second largest area of tropical rainforest, and largest, most biodiverse area of marine ecosystems. It is also home to the world's fourth largest and still rapidly growing population, who are pursuing increased economic well-being. Indonesia's governance arrangements are notoriously complex and dynamic; rapidly changing legislation and shifting hierarchies of control have beset the stewardship of natural, economic, and social assets with difficulties. By global standards, Indonesia is a relatively new nation-state, highly diverse socially and ethnically, and is still in the process of establishing a stable form of government, which all contributes to this complexity. Indonesia's development threats and opportunities, alongside its rich but degrading natural resources demand governance that can deliver optimal outcomes for people and nature – for Indonesians, and the world. I therefore think lessons learned from Indonesia are worth pursuing and can contribute insights for broader global sustainable development solutions.

Overarching questions

My thesis is one of several PhD projects working collaboratively between James Cook University's Development Practice Program (DPP), University of British Columbia's Faculty of Forestry, and the Center for International Forestry Research in Bogor, Indonesia, focused on building capacity for strategic scientific engagement in landscapes in order to understand and influence sustainability. I pose the following research questions; each chapter contributes to a sum of arguments that provides insight into ways of achieving sustainable and inclusive development.

1. What are the leverage points in our landscapes for optimal interventions that lead to long-term sustainable development outcomes? (Chapter 1,6)

2. What are the implications of spatial development initiatives for livelihoods and the environment within a landscape? (Chapter 2, 3, 4, 5)

3. How can we help build communities of commitment for long term societal co-learning in order to promote adaptive, sustainable development –aka *sustainagility*[3] (Jackson et al., 2010)? (Chapters 5, 6)

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[3] *Sustainagility* refers to the properties and assets of a system that sustain the agility of agents to adapt

The components of this thesis are further explained in the structure section at the end of this introduction.

Background

What drives development

Across the tropics, infrastructure is driving environmental, social, and economic change in rural landscapes, transforming social-ecological systems (Laurance et al., 2014, Westen and Zoomers, 2011, Alamgir et al., 2017, Pfaff et al., 2018, Weng et al., 2013, Sayer and Cassman, 2013, Sayer et al., 2012). Large-scale investments in resource exploitation are transforming livelihoods, yet also placing enormous pressure on ecosystems. These investments are often programmatic, part of regional or national development strategies and are termed spatial development initiatives (SDIs[4]) (Ascher, 1999). SDIs are used as a development strategy throughout the tropical developing world. They have a longer history of use in Africa than elsewhere and centre around infrastructure, aiming for broad-based development (Kuhlmann et al., 2011). Their execution relies upon coordinating hard and soft infrastructure development among a variety of stakeholders in a geographically explicit space.

In contrast with outreach programs that aim to alleviate poverty, SDIs aim to induce transformative change: supporting economic growth and productivity in specific regions, promoting investment, generating employment, and establishing and accessing new markets (Weng et al., 2013, Galves Nogales, 2014, Kuhlmann et al., 2011). The logic for development is that development initiatives will geographically consolidate around efficient distributions of market-driven business opportunities – a process referred to as densification. Densification also means enhancing the development benefits through both backward and forward linkages to improve supply chains and facilitate the ability of local small and medium enterprises to provide more goods and services locally.

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and meet their needs in new ways. In contrast, sustainability tends to invoke persistence along current trajectories, and the resilience to return to current baselines. See Jackson et al (2010).
[4] I define an SDI as a targeted intensification of economic activity in an explicit space (adapted from Gálvez Nogales, E. 2014)

The main drivers of SDIs are typically industrial; i.e. they are companies with the capital and political connections needed to acquire large or valuable tracts of land for their development projects. Recently, China's influence has surged across the tropics through its Belt and Road Initiative (BRI). China's commitment to infrastructure development far exceeds humanity's previous infrastructure investments. The BRI involves "half the planet, USD 8 trillion in expenditures, and 7,000 infrastructure and extractive-industry projects" (Ascensão et al., 2018). Conservationists lament these investments and focus on ways to bring big infrastructure projects to a halt (Laurance, 2018). But development scholars place great importance on the role of infrastructure in poverty reduction (Aggarwal, 2015, Acheampong et al., 2018). Tradeoffs between nature and development, and the idea that conservation cannot succeed alongside poverty (Sunderlin et al., 2005), inspired the movement to integrate conservation and development initiatives (Sayer and Campbell, 2004). Ultimately, the governance of infrastructure investments will evolve alongside and help determine how SDIs change the world—economically, geopolitically, and environmentally – for better or for worse (Pfaff et al., 2018, Grindle, 2004).

Recent SDIs in tropical countries have taken the form of industrialised agriculture or extractive industries, including oil palm and rubber plantations, pulp and paper production, and mining. The infrastructure supporting SDIs has the potential to deliver benefits to the 1.4 billion people living in extreme poverty, more than two thirds of whom reside in rural areas of developing countries (IFAD, 2010). New roads, ports, electricity and communication networks can provide access to markets, healthcare and education (De and Iyengar, 2014). However, poor design and implementation of SDIs can lead to economic disparities, corruption, elite capture, and rent-seeking - diminishing opportunities for inclusive and just development. Further marginalisation of already vulnerable groups should be avoided and rectified (Subedi, 2012, Colchester et al., 2006). Governance should help nurture, and be nurtured by SDIs so that policy implementation and management leads to fair and just resource ownership, accumulation, distribution, and transformation (Chomitz et al., 2007). The arrangements, capacity and processes of our institutions should catalyse better coordination, cooperation, and commitment to reconcile conflicting objectives to deliver optimal social-ecological- economic outcomes for inclusive

development (Gupta et al., 2015). The main questions asked by this thesis (outlined above) interrogate how the arrangements, processes, and capacities can be deployed to better fulfil these needs.

Indonesia

At the start of this research, Indonesia's integrated SDI concept was called the Masterplan for Acceleration and Expansion of Indonesia's Economic Development (abbreviated to MP3EI). It envisaged the development of many integrated SDIs, appropriately designed to specific landscapes. Many of the SDIs are inevitable and driven by economic growth and rising demands from the world's burgeoning middle classes, particularly in China. SDIs are opening up undeveloped parts of Indonesia, particularly in the east. Some consider that the eastern Indonesian context demands different development models to those common in western Indonesia (Margules et al., 2015). Landscapes sit at different points along the forest transition curve, the shift from deforestation to reforestation (Rudel et al., 2005, Mather, 1992). In general, Indonesia's management of forest transitions has led to mixed results. Reforestation efforts have been particularly problematic (Barr and Sayer, 2012). Land cover change is driven by investments in mining, and estate plantations such as oil palm and pulp and paper monocropping systems. The deforestation as a result of these industries has created worldwide controversy, which has steered scientific, media, and environmentalists' attention toward reforestation efforts, benefit sharing, and Corporate Social Responsibility. Proliferations of studies have analyzed various facets of oil palm systems and estate cropping (see Chapter 4: *Estate Crops More Attractive than Community Forests in West Kalimantan*). Mining has garnered less attention but is considered a significant threat due to its insidious first-cut into remote places (see Chapter 5 *Comparative development benefits from small and large scale mines in North Sulawesi).*

There is a disconnect between the official development discourse in Indonesia and the on-the-ground realities. Higher levels of government discuss development benefits of investments, while on the ground, social inequities proliferate and hidden environmental costs remain unrecognized and unmonitored (Dove and Kammen, 2001). Some instances of 'development failure' have been recognized only when they could not be ignored, with identification made possible by technological advances and remote sensing capabilities – an example being the forest fires in Kalimantan (Dove and Kammen, 2001). Concern over industrial practices that lead to

environmental degradation, usually deforestation, is widespread among human rights and environmental activists (Li, 2017). Community advocate groups claim that social injustices have gone unnoticed while industries grapple with issues of their environmental reputation. Much of the socio-political scrutiny in Indonesia has thus far focused on higher levels of government, whereas ethnographic studies have focused primarily on the governed, not the governing. There is, therefore, a gap in understanding the scalar interactions between the governance structures among resource stewardship agents and actors.

Road to sustainability

Consensus among conservation and development practitioners is emerging about how to handle social-ecological complexities and achieve inclusive development (Gupta et al., 2015). One growing consensus is that a landscape scale is where broader sustainability challenges are most manageable (Kusters et al., 2017). Additionally, there is consensus that effective place-based and scale-appropriate management of landscapes must enhance and be enhanced by governance - across sectors and scales (Ros-Tonen et al., 2018, Opdam, 2018). To reconcile the scale paradox, it is necessary to co-generate knowledge with decision makers and landscape equity holders, to influence the narratives and discourses at multiple scales so that management aligns with visions of development, where resource use decisions and actions occur (Tengö et al., 2017, Mauser et al., 2013, Lang et al., 2012). Institutional arrangements, capacities and fundamental governance weaknesses must be improved to ensure that wins and winners have non-zero-sum relationships with the rest of their social-ecological systems (Riggs et al., 2018b). This does not mean entirely win-win, as trade-offs are inherent and unfold at different times and at different spatial scales; but it does mean 'winning more and losing less' (Ros-Tonen et al., 2018, Sayer, 2013)

Concepts

Landscape transitions are implicit in SDIs. Landscape transitions are associated with forest transition theory and environmental Kuznets curve hypotheses. Environmental Kuznets curves describe the relationship between environmental quality alongside economic development (Dasgupta et al., 2002). The curve is an inverted U-shape, showing that environmental quality deteriorates at the early stages of economic development and subsequently improves during the later stages, though rarely returning pre-development conditions. Forest transition theory links

the same pattern to forest extent – decreases followed by increases alongside development (Bhattarai and Hammig, 2004, Koop and Tole, 1999, Mather, 1992). The environmental services that result from forest transitions are well known and include soil and water quality improvements, climate-change mitigation, and to a lesser extent, biodiversity improvements (Rudel et al., 2005). Economic and governance arrangements are often problematic, leading to displacement of negative environmental impacts (leakage or negative externalities), and as such, net benefits remain elusive (Meyfroidt et al., 2010). SDIs must include improved landscape level, polycentric governance arrangements if the benefits of asset conversions are to accrue equitably to all people with agency and equity in the landscape (Barbier and Tesfaw, 2015). Governance arrangements should ensure that shared prosperity between people in the landscape and external actors leads to learning in ways that modifies the behavior of all actors (Riggs et al., 2018c). Behavior should change towards effective and efficient resource consumption patterns while increasing resource conservation efforts.
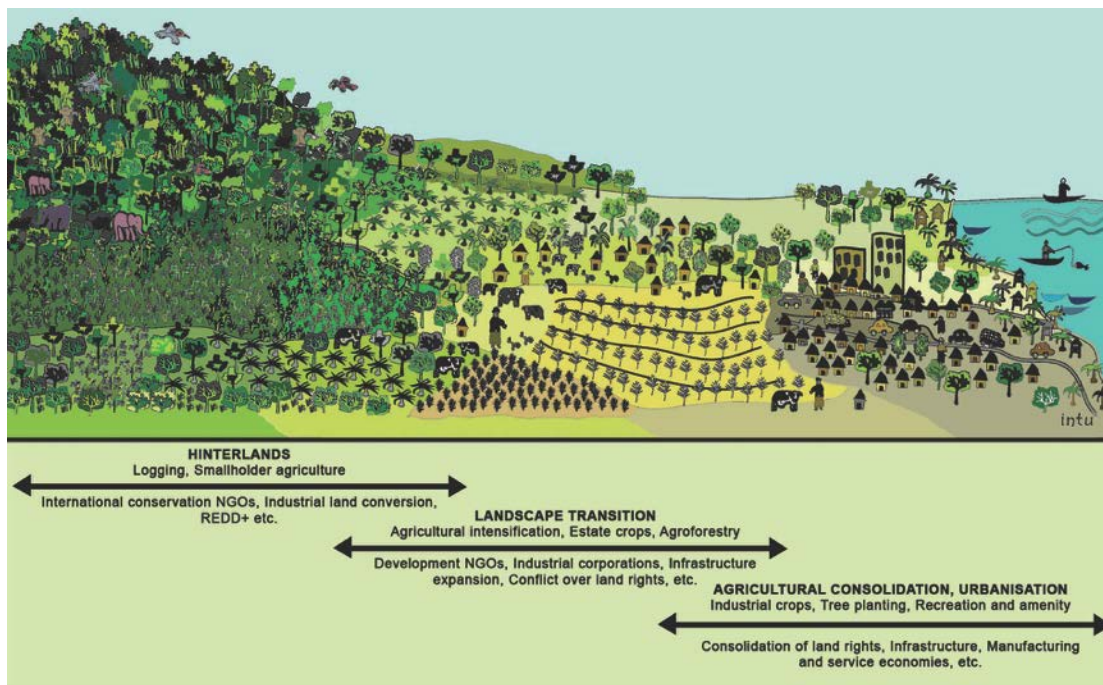

Figure 1. Landscape transition from Sayer et al. (2016)

The logic behind better management of forest transitions can be used to justify intervening in contested landscapes that are on the verge of change - that development leads to better

environmental outcomes. Environmental Kuznets curve theory suggests that enhancing livelihoods through equitable economic development leads to a situation where conservation successes are possible. Recent empirical data supports the presence of Environmental Kuznets curves in Asia (Apergis and Ozturk, 2015). However, a consequence of the local specificity of and multi-scaled influences on landscapes, is that the science of nurturing well managed forest transition is fraught with inefficiencies and special challenges (Sloan, 2015). Regardless of the challenges and oft-contested Kuznets curve philosophy, aiming for transitions has merit because of the potential pathways out of poverty and increased environmental benefits. Therefore, understanding and influencing landscape transitions places the same demand on scientists as the SDGs, and for similar reasons (Sloan, 2015, Meyfroidt and Lambin, 2011). The goal is to establish a way to manage change in landscapes that are targets of SDIs, and that are on the verge of change, so that societies can develop sustainably.

The integrated landscape approach to governing SDIs

As SDIs are a long-term process involving multiple stakeholders, they cannot be governed by a single institution. Stakeholders representing all facets of society have a role in determining their implementation, from local Indigenous groups to global development banks. Governance of SDIs is therefore about power and relationships. It is "the interactions among structures, processes and traditions that determine how power and responsibilities are exercised, how decisions are taken, and how citizens or other stakeholders have their say" (Graham et al., 2003). The primary challenge for SDIs is therefore ensuring meaningful engagement from stakeholders across scales, reconciling conflicting objectives and building consensus among stakeholders towards desirable social and ecological goals. Policies should concurrently target specific regions, key economic sectors and households. Collaborative and effective governance, considered to be 'polycentric' and/or 'multi-level' is fundamental for building trust between stakeholders, ensuring fair and equitable outcomes and overcoming divisions between opposing institutions (Nagendra and Ostrom, 2012).

Minang (2015) stresses the need to find leverage points for optimal management results. Leverage points are the places where small changes can generate bigger changes in the entire system (Meadows, 1999). Transdisciplinary sustainability science can help in the diagnosis of

systems to find leverage points and for constructing theories of change for systemic change. We acknowledge that there are no firm endpoints for 'secured' landscapes, and that engineering a 'grand design' is unlikely to maximize the benefits or manage the conservation and development trade-offs in an equitable, just and sustainable fashion (Sayer et al., 2008). Policies must concurrently target specific regions, key economic sectors and households. The landscape approach is one attractive method for dealing with the complexities of transitions at a manageable scale.

The term *landscape* is used to describe a diverse social-ecological system bounded in space where problems need solving. Building capabilities at a *landscape* level therefore requires an integrated and transdisciplinary approach, known as *integrated landscape approaches* (Reed et al., 2016). Specifically, a landscape approach can be considered "a long-term collaborative process bringing together diverse stakeholders aiming to achieve a balance between multiple and sometimes conflicting objectives in a landscape or seascape" (Sayer et al., 2016). Non-governmental organizations, research institutions, private organisations and governments can use this approach to engage with stakeholders across scales and across sectors, creating platforms for decision-making and reconciling trade-offs. Once a platform for engagement is established, stakeholders can build a management coalition to govern the implementation of SDIs, ensuring accountability, transparency and representation from the entire landscape (Sayer et al., 2016, van Noordwijk, 2017).

Research approach: a practical political ecology

This is not solo or narrowly focused component research; it is research conducted by a team of committed practitioners in academia that are trying to influence trajectories of development in tropical forested landscapes using a sentinel landscape approach (Langston and Riggs, 2017). I am privileged to be a member of that team. We work at the interface of academia and practice and do not affiliate with any single academic 'discipline', rather we aspire to be 'ill-disciplined' (Chambers, 2014). We are concerned with places and how to achieve sustainability, using what works from a constructivist's perspective, rather than a positivist one. This means exercising inductive methods upfront before any hypothesis or experiment is tested.

Rather than provide deep scholarly critiques of development that are detached from the actual development processes, this research aims to collaboratively problem-frame and constructively contribute to solving the problems faced by people and their landscapes by being a part of the development processes. We use transdisciplinary sustainability science for its usefulness in both knowledge production and for solving societal problems (Clark, 2007). Lang et al. (2012) describe three phases of transdisciplinary sustainability science (1) the collaborative problem identification phase, (2) the co-production of problem and solution-oriented knowledge, and (3) the integration and application of the knowledge into scientific and societal practices. Our research aims to be inclusive of all sources and types of knowledge and to be 'problem-driven, iterative & adaptive' (Andrews et al., 2013).

We blend landscape approach principles (Sayer et al., 2013) with transdisciplinary sustainability science to co-produce knowledge in landscapes with local landscape equity-holders to achieve better development outcomes. This involves efforts to embed science - the broad range of disciplines – into social-ecological systems. We strive to do this by collaboratively diagnosing the polycentric governance arrangements – where the actors, and their associated knowledge systems influence development outcomes. Actor networks provide insights where we, alongside landscape stakeholders, can co-produce knowledge to build communities of commitment around narratives that are more inclusive and sustainability-centric. The objective is to build consensus, and enhance capacities, leading to improved policies and management outcomes (Nel et al., 2016).

We label the blend of landscape principles and transdisciplinary sustainability science a *sentinel landscape approach*. A sentinel landscape approach puts research institutions in a unique position to influence change. This approach involves deep engagement and reflects the need to do research *in* development, rather than *on* development or even research *for* development. Rather than transfer skills from one place to another it reflects our pedagogy to cogenerate knowledge, learn together for change, and increase our collective emotional intelligence and empathy. It is action-research (Bradbury-Huang, 2010, Brydon-Miller et al., 2003, Reason and Bradbury, 2001) in places where we have partners and aim to influence, and learn from, change. The moral imperative of making progress toward the 2030 Agenda means working

collaboratively for people, planet, and prosperity. We aim to influence change by convening management coalitions with the full-range of actors in the landscape and developing theories of change with them and building communities of commitment for long term adaptive management of resources. Our methods for doing so have evolved over the course of this research, and include methods described in the following chapters of this thesis. The final chapter of this thesis describes more of the details of the lessons learned from our approach. For a paper not included in this thesis, we derived a generic theory of change (Figure 2) that shows how transdisciplinary sustainability science can engage with landscape approaches, how science might value add to improve development outcomes.
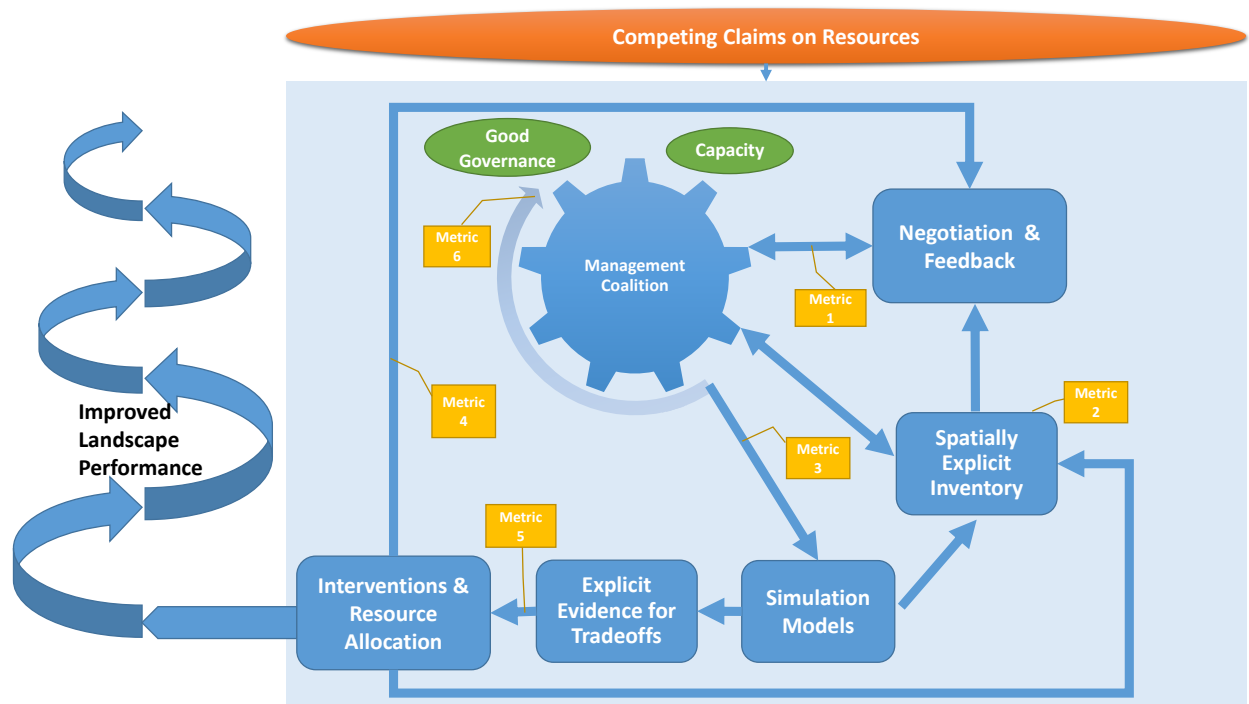
Figure 2. Generic theory of change for social-ecological systems in landscapes from (Sayer et al., 2016). A management coalition drives progress towards ultimate goals. Arrows show the direction of movement of the system. Good governance and capacity are positive feedback variables. Competing claims provide the justification for the process. Metrics for tracking progress correspond to the critical processes, which are shown as numbered boxes: (1) negotiation and communication of clear goals, (2) a clear and agreed theory of change, (3) a rigorous and equitable process for continuing stakeholder engagement, (4) connection to policy processes and key actors, (5) effectiveness of governance, and (6) transparency.

We aim to meet the needs of the practitioners and people living in the landscape while continuing to learn from and improve integrated landscape interventions for implementing SDIs. We also aim to influence conservation and development sciences to shift more towards problem-driven engagement and systemic embeddedness and away from deconstructions from afar (see Chapter 6). As landscape practitioners, the aim is to build capacity at a local level while having access to resources and capabilities to guide policy and processes at a larger scale. Just as infrastructure gives rise to multi-dimensional impacts at different temporal and spatial scales, we need a holistic approach to understanding and managing change in landscapes. Sustainable infrastructure development requires a collaborative approach to governance. Governments, private companies, civil society and research institutions all have a role to play.

Thesis structure:

Chapter 1: Discourses mapped by Q-method shows governance failings motivate landscape approaches in Indonesia (Langston et al., 2019a).

Chapter 2: Comparative development benefits from small and large scale mines in North Sulawesi (Langston et al., 2015)

Chapter 3: Estate Crops More Attractive than Community Forests in West Kalimantan (Langston et al., 2017).

Chapter 4: Governance challenges in an eastern Indonesian landscape (Riggs et al., 2018a); I contributed to the conceptual framing, data collection and analysis, and original writing and subsequent edits of the paper.

Chapter 5: Conservation and development pressures intensify on one of Indonesia's least developed large islands, Seram (Langston et al., Submitted).

Chapter 6: Science embedded in local forest landscape management improves benefit flows to society (Langston et al., 2019b)

Conclusion

Other articles that I have authored or co-authored over the course of my PhD and are relevant to my thesis and to the outcomes of our lab include:

1. Sayer, J., Boedhihartono, A. K., Buchori, D., **Langston, J. D.,** Margules, C., Riggs, R. A., & Sari, D. A. (Submitted). New institutional arrangements needed to foster forest landscape restoration in Indonesia. Land Use Policy.

2. Margules, C., Boedhihartono, A. K., **Langston, J. D.,** Riggs, R. A., Sari, D. A., Sarkar, S., Sayer, J., Supriatna, J., Winarni, N. L. (Submitted). Re-focusing Conservation Science. BioScience.

3. Sayer, J., Sheil, D., Galloway, G., Riggs, R. A., Mewett, G., MacDicken, K. G., Arts, B., Boedhihartono, A. K., Edwards, D. P., **Langston, J. D.** (2019). Life on land - The Central Role of Forests in Sustainable Development. In Sustainable Development Goals: Their Impacts on Forests and People: Cambridge University Press.

4.   Riggs, R. A., **Langston, J. D.**, & Sayer, J. (2018). Incorporating governance into forest transition frameworks to understand and influence Cambodia's forest landscapes. Forest Policy and Economics, 96, 19-27. doi:https://doi.org/10.1016/j.forpol.2018.08.003

5.   Bull, G., Boedhihartono, A., Bueno, G., Cashore, B., Elliott, C., **Langston, J.D.**, Riggs, R.A., Sayer, J. (2018). Global forest discourses must connect with local forest realities. International Forestry Review, 20(2), 160-166.

6.   **Langston, J.** (2017). To conserve forests, we need to think beyond current ideas of integration or segregation. The Conversation. Retrieved from https://theconversation.com/to-conserve-forests-we-need-to-think-beyond-current-ideas-of-integration-or-segregation-75291

7.   **Langston, J. D.**, & Riggs, R. A. (2017). Improving infrastructure governance: the Sentinel Landscape Approach. Retrieved from https://www.jcu.edu.au/__data/assets/pdf_file/0004/473503/SOTT-2017-Infrastructure-Report.pdf

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9.   Sayer, J. A., Margules, C., Boedhihartono, A. K., Sunderland, T., **Langston, J. D.**, Reed, J., Riggs, R., Buck, L. E., Campbell, B. M., Kusters, K., Elliott, C., Minang, P. A., Dale, A., Purnomo, H., Stevenson, J. R., Gunarso, P. & Purnomo, A. 2016. Measuring the effectiveness of landscape approaches to conservation and development. Sustainability Science, 12, 465-476.

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11. **Langston, J.**, & Turton, S. M. (2014). Industry-adaptation pathways and opportunities in the Wet Tropics cluster. In C. Moran, S. M. Turton, & R. Hill (Eds.), Adaptation Pathways and Opportunities for the Wet Tropics NRM Cluster Region: volume 2: infrastructure, industry, indigenous peoples, social adaptation, emerging planning frameworks, evolving methodologies and climate adaptation planning in practice (Vol. 2, pp. 128-143). Cairns, QLD, Australia: James Cook University.

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Chapter 1: Discourses mapped by Q-method shows governance failings motivate landscape approaches in Indonesia

RESEARCH ARTICLE

Discourses mapped by Q-method show governance constraints motivate landscape approaches in Indonesia

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Abstract

Interpreting discourses among implementers of what is termed a "landscape approach" enables us to learn from their experience to improve conservation and development outcomes. We use Q-methodology to explore the perspectives of a group of experts in the landscape approach, both from academic and implementation fields, on what hinderances are in place to the realisation of achieving sustainable landscape management in Indonesia. The results show that, at a generic level, "corruption" and "lack of transparency and accountability" rank as the greatest constraints on landscape functionality. Biophysical factors, such as topography and climate change, rank as the least constraining factors. When participants considered a landscape with which they were most familiar, the results changed: the rapid change of regulations, limited local human capacity and inaccessible data on economic risks increased, while the inadequacy of democratic institutions, "overlapping laws" and "corruption" decreased. The difference indicates some fine-tuning of generic perceptions to the local context and may also reflect different views on what is achievable for landscape approach practitioners. Overall, approximately 55% of variance is accounted for by five discourse factors for each trial. Four overlapped and two discourses were discrete enough to merit different discourse labels. We labelled the discourses (1) social exclusionists, (2) state view, (3) community view, (4) integrationists, (5) democrats, and (6) neoliberals. Each discourse contains elements actionable at the landscape scale, as well as exogenous issues that originate at national and global scales. Actionable elements that could contribute to improving governance included trust building, clarified resource rights and responsibilities, and inclusive representation in management. The landscape sustainability discourses studied here suggests that landscape approach "learners" must focus on ways to remedy poor governance if they are to achieve sustainability and multi-functionality.

Introduction

Landscape scale interventions to achieve economic development while supporting environmental integrity are being promoted in Indonesia as a means to achieve the Sustainable Development Goals [1]. Commonly referred to as 'landscape approaches', these interventions are used in intergovernmental initiatives and by governments, by research and academic institutions, NGOs, as well as the private and business sectors [2]. Such space-based approaches are considered preferable to 'commodity' based approaches to managing the environmental, social, and economic sustainability of global production systems [3–5]. The attraction of landscape approaches is the perceived potential for delivering conservation and development synergies and minimizing trade-offs [6]. Landscape scales are considered by many to be where broader sustainability challenges are most manageable [7]. Recent discourse has suggested that the global sustainable development community might coordinate to unlock 'potentially trillions' of dollars to be directed into landscape approaches for achieving sustainable development [8]. Such approaches are, of course, compelling and have permeated almost all corners of the development and conservation discourse. Yet, in reality, long-term and sufficient funding for the conservation of natural resources and economic development of rural societies remains elusive.

Common conceptions of landscape approaches cover a substantial diversity of actions, applied in a range of contexts [1]. To-date there remains a lack of consensus on what a landscape approach really entails [9]. There is, as yet, no widely accepted definition of a landscape approach, primarily because some landscape approach theorists maintain that there should not be a singular rigid definition as these sorts of integrated geographically defined approaches have to be used in a diversity of contexts [10]. Broadly, a landscape approach can be considered "a long-term collaborative process bringing together diverse stakeholders aiming to achieve a balance between multiple and sometimes conflicting objectives in a landscape or seascape" [2]. Landscape approaches adhere to a set of principles that are meant to steer the governance of landscapes to better reconcile and integrate conservation and development efforts [11]. They involve integrating land management with aim of enhancing social and environmental outcomes for the sake of sustainable and inclusive development [12]. While landscapes, considered as social-ecological systems, are the entry unit for analysis and implementation, landscape approach principles explicitly consider multi-scalar interactions and outcomes. Landscapes are not delimited by environmental variables such as watersheds, or political variables such as jurisdictions, rather by a combination of social and environmental determinants. There is a growing body of literature exploring the origins, history, and evolution of landscape approaches [10, 13–17], but some are concerned that a lingering 'conceptual capaciousness' means that the majority of integrated approaches, and most environmental governance, can resemble the landscape approach, therefore detracting from its meaning [18]. While a set of principles and guidelines [11] and generic theories of changes [2, 19] for landscape approaches have been developed, more rigorous conceptual and analytical frameworks are largely missing [18]. Due to the scope and transdisciplinary nature of landscape approaches, there remains a wide range of terminology and ontological divergences on how landscape approaches are applied in practice [13].

Landscape approaches are not immune from critique. Some are concerned with unrealistic claims of win-win goals [20] and the difficulty in their application [21], while some claim landscape approaches are being used to de-politicize the problems apparent in social-ecological systems and entrench neoliberal exclusionary development [22, 23]. The pre-conditions for successful landscape approaches are indeed daunting [24], but there are growing interests in ways to co-generate knowledge and policy to redress inequalities. Some of those tools are discussed elsewhere [25, 26].

Knowledge is often contested between multiple actors in complex landscapes [27, 28]. If implementers of landscape approaches are going to succeed in achieving their goals, they must come to terms with the actors and discourses at multiple scales; problem framing must be rigorous and collaborative [29]. This is because the challenges of social-ecological systems are complex and often stem from poorly coordinated decisions, where different elements of society frame problems in terms of their own needs and aspirations, leading to unsatisfactory, and often conflicting, zero sum outcomes [7, 30, 31].

A recent review shows the prevalence of the use of landscape approaches in South and Southeast Asia [6]. In Indonesia, investments that are driving change [32], are sought to be governed by landscape approaches [4, 30, 33, 34]. Indonesia has adopted broader landscape approaches in the implementation of projects to Reduce Emissions from Deforestation and Forest Degradation (REDD+), ecosystem restoration concessions, and forestry management units (Kesatuan Pengelolaan Hutan or KPH). The largest estate crop companies are moving towards the implementation of landscape approaches as part of their sustainability strategies [35]. But studies have shown that landscape governance does not usually come from formally planned legislation, rather through "institutional bricolage", where diverse actors create new institutional space by creatively combining local institutions with externally introduced mechanisms, constructing hybrid institutions adapted to landscapes social-ecological contexts [28, 36]. Consequently, landscape approaches resemble 'muddling through' [37], as implementers realize grand designs fail to deliver satisfactory sustainability outcomes [38]. They should 'not be seen as prescriptive approaches to spatial planning' [2].

In Indonesia, the challenges for sustainable and inclusive development are writ large. The country contains the world's second largest tropical rainforest, and the most extensive and most biodiverse marine ecosystems [39, 40]. It is also home to the world's fourth largest, rapidly growing, and culturally diverse population, who are pursuing economic well-being [41, 42]. Indonesia's governance arrangements are notoriously complex and dynamic; rapidly changing legislation and shifting hierarchies of control have beset the stewardship of natural, economic, and social assets with difficulties [30, 43–45]. Many development benefits have often accrued inequitably, especially where large investments drive landscape scale change [46, 47]. Indonesia's development threats and opportunities, alongside their rich but degrading nature demand governance that can deliver optimal outcomes for people and nature [4, 48]. An in-depth discussion of the sustainability discourses in Indonesia is beyond the scope of this paper because our primary goal is to use a relatively objective method to illuminate the issues of landscape sustainability according to landscape sustainability experts who, we hypothesize, all have their own interpretations of the context of sustainability in Indonesia.

The vast array of different and contextualized social-ecological conditions in Indonesia means there are now a variety of diverse applications of the already conceptually vague landscape approach [18]. The broad range of understandings means that even within a single landscape, implementers are likely to diverge in their perspectives as to what the obstacles are for landscape sustainability. Rather than become a discursive barrier, different perspectives can be made transparent, and if management coalitions account for them, they can enable more equitable delivery of benefits to a broad range of actors within a landscape. As a transdisciplinary team attempting to influence development outcomes in Indonesia, the authors and participants of the study are inspired by this diversity to achieve greater understanding on what the obstacles are for landscapes if we are to influence and understand their development trajectories.

Considering what is at stake in Indonesia's landscapes both for people and their environment, the sustainability challenges deserve greater attention: what are the problems, and according to whom? Opportunities to learn from the existing set of circumstances as well as

the diversity of approaches depend on how we interpret the variation among discourses of those involved in landscape approaches in the field. Q-methodology [49] has shown potential for uncovering underlying narratives of sustainability, resource management, and development issues, wherein power and politics drive decisions [50–52]. The method combines unique qualitative and quantitative research principles [53]. Q is particularly suitable for studying highly debated and contentious phenomena, such as landscape approaches, because it aims to identify different or shared ways of thinking on a topic, keeping the researcher's perspective relatively independent from the procedure and results [54].

Clear evidence enables systemic learning [55] and defining stakeholder perspectives can be useful for both knowledge brokers and boundary institutions [27] aiming to influence or induce change in complex and contested landscapes [56–58]. Articulating the full range of stakeholder perceptions supports legitimacy and buy-in to any intervention aimed at solving problems affecting social-ecological systems [59]. Clarity of points-of-view is critical in the complexity and ambiguity caused by de-and re-centralization of governance arrangements such as in Indonesia [60]. Indonesia's knowledge brokers and boundary institutions would then be more able to leverage points of consensus and address controversies, fundamental to building the trust necessary for reconciling the trade-offs inherent in integrated landscape initiatives [7, 20]. Zabala, Sandbrook [61]show that applying Q-methodology uniquely allows identification of the range of nuanced perspectives in a structured way. Furthermore, Q helps identify divergence and consensus around key topics, which can then be used to facilitate critical reflection among actors and assess management strategies.

This paper heeds a call by Opdam [62] for scientific methods to better interact with social processes, to bridge the gap between science and practice by grappling with underlying narratives of landscape sustainability. During a gathering of landscape approach practitioners and associated academics we explored perspectives on what prevents landscapes in Indonesia from functioning as well as they could. Functionality was not considered by the group to be an endpoint [63]. Functionality was conceived to mean improved sustainability—delivering multiple goods and services to satisfy the full range of actors in an equitable and accountable way. Functionality was not defined according to normative or concrete criteria, rather the goal was to explore the full range of the participants internal understandings of sustainability, and how sustainability is constrained in 'places'[64]. Through our discourse analysis we identified points of divergence and consensus over core concepts and we identify vantage points people have when using landscape approach principles in their work or research. Our results contribute to more comprehensive narratives on what motivates the implementation of landscape approaches, reducing the ambiguity surrounding landscape-scale sustainability in Indonesia. We conclude that to effectively coordinate landscape interventions for achieving impact, investments must contribute to rigorously transparent evidence-based problem framing. Management coalitions that allocate resources must understand where peoples' values intersect politically, and they must be accountable to their own divergent political vantage points when seeking to remedy inadequate governance.

Methods

Setting

In September 2017, during a gathering of landscape approach practitioners and associated academics at a 'Learning Landscapes' retreat in Indonesia, we took the opportunity to explore the perspectives on what prevents landscapes in Indonesia from functioning as well as they could, as discussed above. The objective of the retreat was to bring together leaders of landscape and seascape initiatives in Indonesia for them to compare approaches, challenges and

achievements. The retreat was held in Setulang Village, Malinau District, North Kalimantan, Indonesia. Malinau district was the location of a major initiative by CIFOR from 1994–2009 to develop integrated landscape approaches to the understanding of large-scale forest transformation processes [65]. Five people who worked on the initiative at that time were present at the retreat. Information and publications from that period were available to the retreat participants; 34 participants were present for all the activities. The idea to perform a Q methodology arose during the retreat, it was not pre-planned. There was consensus among the participants that exploring the potentially wide-ranging views among the retreat attendees would stimulate debate and would lead to a more rewarding 'learning landscapes' retreat. The specific methodology was proposed to the group and all attendees gave consent verbally and were enthusiastic to participate in the exercise. Ethics approval for this study was obtained from the James Cook University Ethics Committee (Ethics Approval Application ID H4756).

Q method

Q-methodology provides a comprehensive approach to the study of perspectives and subjectivity [49, 66, 67]. It uses abductive reasoning to understand the viewpoints and the differences in a sample population. Abductive logic, as opposed to deductive or inductive logic, involves seeking the most likely explanation from an acknowledged incomplete set of observations. Q-methodology can reveal complexity of values and perspectives that are not obtained by standard surveys. For these reasons it has been used to study other development, sustainability, and natural resource issues [49, 54]. Our three main steps in applying the Q-method were: 1) developing a concourse, 2) obtaining Q-sorts of these statements from 34 participants, 3) analysing the data for overall level of agreement, and for recognizing distinguishable discourses with a principal component analysis.

Fig 1 describes the process of our Q method application. The overall issue was the overarching theme of the retreat: landscape approach challenges and achievements. We determined the Q-question "what prevents landscapes in Indonesia from functioning as well as they could?" out of consideration for the pertinent question for practitioners: what hinders change in the landscapes that we are trying to influence onto trajectories of sustainability?

To develop a concourse, we collected statements from all of the 34 participants (P-set). Participants formed statements on the basis of their knowledge of the impediments to achieving landscape level sustainability in Indonesia, whether through experienced project implementation or independent observation. The statements were in response to a question: "what prevents landscapes in Indonesia from functioning as well as they could?" Participants could suggest as many statements or phrases as they deemed sufficient to capture the range of issues that were important. In this case the participants listed 120 phrases in total. Concourse analysis [66] seeks to capture the full breadth of discussions related to the issue, the results of which becomes the raw material for the Q-sample (the set of questions used for the Q-sorting). We deemed the 120 statements sufficiently diverse, capturing the full breadth of the potential factors influencing landscape functionality. We distilled the 120 statements to 41, our final Q-sample (Fig 1). We reduced the statements by combining similar statements into themes and then combined aspects of similar statements to reduce specific overlaps. When eliminating specific statements, we did so in a way that minimized the loss of the diversity of ideas from the original set of themes.

Our P-set (n = 34, 25 males) was comprised of a variety of academics and practitioners, with some straddling both domains. We selected the 34 participants to capture a wide diversity of (1) sectors of society, (2) reasons for implementing landscape approaches, and (3) degrees of practitioner and academic involvement. All participants were familiar with the theory of
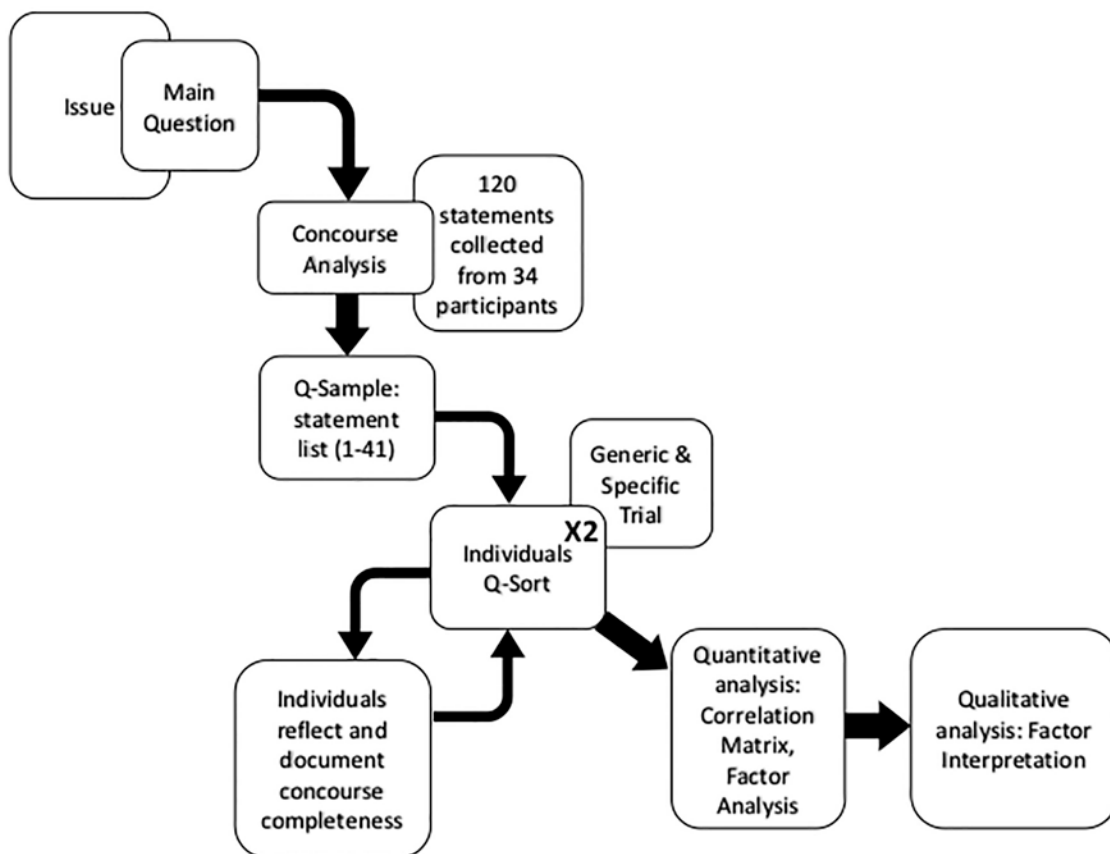
Fig 1. Q methodology flow diagram for our study.

landscape approaches [11], and the challenges of their application [2] ahead of the retreat. The majority of the participants had been involved in the application of landscape approaches in either one or many initiatives, within Indonesia or globally. All were familiar with the Indonesian context through their knowledge of CIFOR's Malinau research forest in the 1990s-2000s and from many other Indonesian case studies. Twenty-one participants were applying their own landscape approach in Indonesia at the time of the retreat. Nineteen participants were Indonesian, fifteen were international including: five Australian, one British, one Dutch, one French, one German, one Irish, one Russian, one Spanish, one Vietnamese, and two from the United States of America. The participants represented different sectors of society: eighteen from academia, two from the private sector, and ten from various NGOs. Four reported straddling both NGOs and academia, and four reported holding civil servant positions while studying in academia. The academics were comprised of Masters' students n = 7, PhD students n = 3, and professors and lecturers n = 8. All students and academics come from development practitioner-based backgrounds. The academics were all applied scientists also working in civil society organizations or private sector companies aiming to steer development trajectories in tropical landscapes. The students were all practitioners enrolled in a 'practice-based' development program with the aim of influencing development from a broad-based, multi-disciplinary foundation. Civil servants represented central government positions in Vietnam and Indonesia, and district level governments in Indonesia.

To obtain Q-sorts from the P-set, each participant took all 41 statements written on square pieces of paper and initially classified them as 'agree', 'neutral' or 'disagree'. Then they placed all 41 statements onto a Q-sort board (see design in Fig 2). Each statement was assigned a number 1–41 and we recorded each participant's final sort, an example of which is shown below in Fig 2. Opportunity to reflect on the 41 statements was provided to each participant after their Q-sort; we asked and documented if there was anything missing from the Q-sample or whether it reflected the comprehensive concourse. All participants were asked to Q-sort twice. Once generally for landscapes in Indonesia, and a second time for a specific landscape they were either familiar with or where they were working. The premise of sorting twice was to interrogate the degree to which participants perceive differences imposed by local context or whether they consider that they can apply a predetermined set of generic concepts applicable broadly.

Analysis

We used an open-source software, Ken-Q Analysis (https://shawnbanasick.github.io/ken-q-analysis/#section1 Version 0.11.0), to build the correlation matrix, perform the principle component analysis, and flag the defining sorts. We ran the analysis separately for the generic trial and the specific trial. Similarities between Q-sorts are identified from the correlation matrix and the principle component analysis classifies information based on the correlations between Q-sorts. We extracted eight principal components and applied a varimax rotation to the first five factors, which cumulatively explained 54% of the variation for the generic trial, and 55% for the specific trial. Choosing how many factors to keep for rotation is based on how many factors are significantly distinct. There needs to be enough factors to represent the sorts of groups represented in the P-set. Each Q-factor is the average perception of respondents with similar views. However, there are no fixed rules for determining how many factors to keep for analysis. Deciding how many factors to keep is a mix of subjectivity and objectivity; "scientists should not make a decision based on statistical rules only, but also use qualitative knowledge of the context" [51]. The results of keeping five factors divided the discourses into sufficiently comprehensible nuanced similarities and differences between groups. Keeping five factors also divided the p-set into intuitively distinct groups of people with Indonesian, international, disciplinary, and workplace backgrounds. The cumulative variance within the P-set at over 50% is used as an acceptable determinant elsewhere [51, 52], so we deemed a 55% variance for both trials using five discourse factors to be most appropriate.

After establishing the discourse factors for the generic trial and specific trial, we examined the distinguishing statements at the 'most agree' and 'least agree' sections of the Q-sort (refer to S1 Table). We derived independent names for the factors and looked for overlaps or differences between the generic and specific trial discourse factors, based on the characteristics of the statements. We labelled the first four discourse factors for the generic and specific trials the same due to their similarity (i.e. discourse factor one in the generic trial received the same name as discourse factor one in the specific trial). One factor in the general trial and one in the specific trial, diverged enough to merit different labels—factor five in the general trial, and factor five in the specific trial.

Defining statements from the Q-sample that were distinguishable from each factor were flagged, significant at $p < 0.05$, according to the standard Q criteria, which includes minimizing confounding factors ($p < 0.05$ labelled in S1 Table, with D, with $p < 0.01$ labelled D*). The P-set is divided up by Q-sort responses closest to each other and a model Q-sort is created for each factor from the results of the factor loading of the flagged Q-sorts. Out of 34 Q-sorts, nine Q-sorts remain without a significant loading—they did not belong to any specific discourse
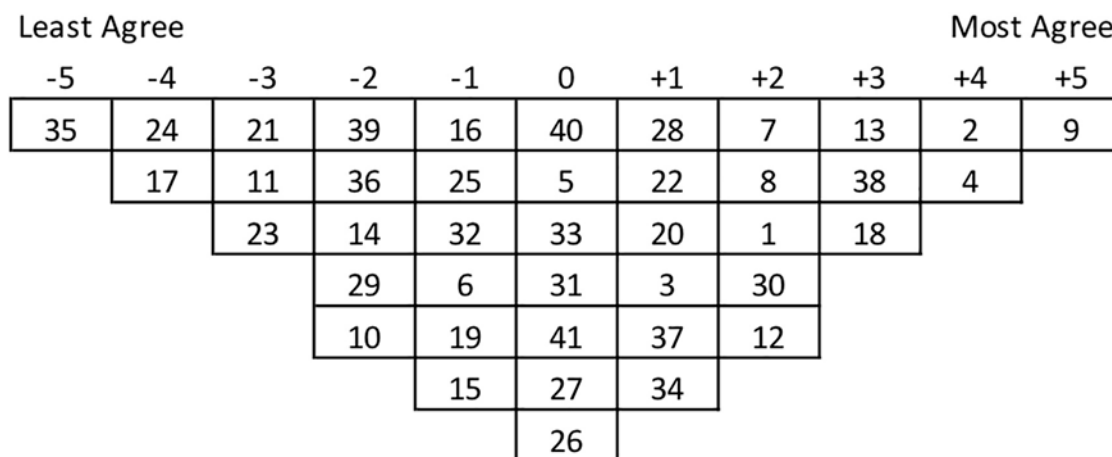
Fig 2. Sample of a Q-Sort. The chart forces a normal distribution for the 41 statements. Each participant must allocate every statement into a box. The numbers in this example represent the statements 1–41 (Fig 3). The position of each statement indicates the level of agreement.

but shared opinions of all other respondents. Factors, henceforth referred to as discourse factors, were interpreted based on the correlation matrix that converted the flagged average of each person's score for each statement to a normalized factor score (or Z-score) to standardize the distribution across the statements.

The following results describe discourses stemming from the Q-sort sample. The narrative which emerges represents their collective experiences and interactions with conservation and development processes. They are not representative of local people living in the landscapes of concern, but that does not discount their solidarity for local people, their interests and their environments. Respondents are a subset of 'landscape approach' experts who have an interest in steering the trajectory of development in tropical landscapes. The limits of the study are therefore bound by the histories and personal perspectives of the participants.

Results

Overall, statements referring to "corruption" and "lack of transparency" scored highest, and statements on agricultural policies and biophysical factors such as topography and climate change, the lowest. When participants considered a landscape they knew best, the results changed slightly: the rapid change of regulations, limited local human capacity and inaccessible data on economic risks increased in relevance, while scores for inadequacy of democratic institutions, overlapping laws and corruption became less important. Both generic trial and specific trial highlight that corruption, lack of accountability, policy and sectoral inconsistencies, weak enforcement of rules and regulations, divergent goals and unsatisfactory stakeholder respect are ranked as the main constraints to landscape functionality. Table 1 shows a list of the most and least constraining factors according to our P-set for both the generic and landscape specific trials. The most illustrative set of main constraints and least constraints fell at a convenient Z-score threshold plus one and minus two (see Table 1).

Discourse analysis

Five discourse factors explain 54% of the variance for the general trial and five explain 55% of the variance for the specific trial. Based on our review of the thematic elements among the distinguishing factors on the 'most agree' and 'least agree' end of the Q-sort discourse factors (see

Table 1. Overall results for biggest and least constraining factors that prevent landscape functionality in Indonesia.

	Degree of constraint	Statement
General trial	Main constraints (Z-score > 1)	Corruption, personal benefits for those issuing permits
		Lack of accountability to civil society, opaque decision making, lack of transparency
		Inconsistencies between sectoral policies and misalignment of government structures
		Weak enforcement of existing regulations, poor monitoring of actual change
		Lack of a common (negotiated, agreed) goal for the landscape as a whole
		Unclear and contested tenure rights, conflicting claims
		Differing goals of stakeholders in the landscape, lack of recognition and respect for various perspectives and interests
		Exclusion or underrepresentation of important stakeholders in decision making
	Least important (Z-score < -2)	Topography constraints to transport, durable roads
		Global climate change, locally changing rainfall patterns
		Rice focus of agricultural policies
Specific trial	Main constraints (Z-score > 1)	Inconsistencies between sectoral policies and misalignment of government structures
		Lack of accountability to civil society, opaque decision making, lack of transparency
		Corruption, personal benefits for those issuing permits
		Weak enforcement of existing regulations, poor monitoring of actual change
		Lack of a common (negotiated, agreed) goal for the landscape as a whole
		Differing goals of stakeholders in the landscape, lack of recognition and respect for various perspectives and interests
		Increased pressure on land and resources leads to government priorities for economic growth over environmental integrity
		Unequal bargaining power, large-scale concessions without local consent
	Least important (Z-score < -2)	Topography constraints to transport, durable roads
		Rice focus of agricultural policies
Variation between general and specific trial	More influential when referring to own landscape (highest positive change)	Regulations change too quickly to be fully applied
		Limited human capacity (knowledge, decision making) within communities and government
		Lack of economic data on risk, price fluctuations, market dynamics
		Slow transition from subsistence focus to active participation in wider economic activities (tie for 3rd)
	Lower influence when referring to own landscape (highest negative change)	Inadequate democratic processes and institutions
		Corruption, personal benefits for those issuing permits
		Overlapping partly contradictory laws with loopholes and lack of grievance procedures

S1 Table), we distinguished six total discourses with the following titles: (1) social exclusionists, (2) state view, (3) community view, (4) integrationists, (5) democrats, and (6) neoliberals. We determined the titles of the discourses from the emergent properties of the 'most' and 'least' constraining statements of each factor. While the general trial and the specific trial both produced five factors for a total of ten factors, eight of them paired. These eight paired as four in each trial because they resembled each other enough to merit the same discourse title. That means one factor in each trial merited different names; the 'democrats' and 'neoliberals' were unique to the generic trial and specific trial, respectively. The first four factors should be considered as discourses with slightly resituated perspectives from general to specific trials. The supplementary material contains a table (S1 Table) comprised of the most and least

constraining statements for each discourse factor, in addition to the rankings of each statement for each discourse factor (S2 and S3 Tables). Figs 3 and 4 show the discourses for the general trial and landscape specific trial respectively, by showing the degree to which statements distinguish from each other at the top, to the degree of consensus at the bottom.

Group 1. Social exclusionists.   The first discourse group perceives the main hindrances to landscapes functionality as a function of the exclusionary nature of development. Immigration is not perceived as an issue due to ideals of inclusive development. Rather, the variety of actors are under the imposition of predatory institutions involved in corruption, patronage, and powerful extractive groups that contribute to a mode of 'accumulation by dispossession' [68]. The group is concerned that decision-makers are not comprised of the full range of people in the landscape and that the decision-making apparatus excludes people (local communities) even though they will affect landscape outcomes. The unimportance of slow livelihood transitions might reflect ideals of rights to self-determination for the people in the landscape, regardless of their origins. The majority of the respondents in this discourse are not Indonesian and have backgrounds in anthropology or on 'people-centric' approaches to development, such as in NGOs working on human rights and conflict resolution. Global and local climate concerns do not concern this group, likely due to the perception that it is fundamentally something people must adapt to, and will adapt to, if they are given equal access to development opportunities. In the specific trial, the constraints distil to basic tenets of democratic process for people, while discounting the policy and regulatory environment. This group sees everyone as deserving a fair chance, supported by institutions with integrity.

Group 2. State view.   Perceptions of respondents that 'see like a State' [69] are related to aspects of effective oversight of legislation, regulation, enforcement, and leadership. Noticeably, immigration is a problem for landscape functionality—this was apparent when participants thought of a specific landscape. The factors that do not hinder landscape functionality are related to knowledge, human capacity, and insufficient freedom of choice for communities. This makes sense if the problems are a matter of executing and following orders. In the landscape specific trial, the main concern over unclear government authority from years of de-and re-centralization disappears [70, 71]. As the participants focused on their landscape, the context of complicated resource use-rights became less prominent, and executive assertions became more prominently actionable. This group was represented primarily by Indonesian nationals who have worked for natural resource management/conservation organizations in multiple areas across Indonesia.

Group 3. Community view.   A community development theme runs through the third discourse group. The main hindrances listed are the justification for what many community development organization do—clarify tenure rights, build consensus and trust, and enhance the adaptive capacity to changing political and project-cycle environments [72, 73]. While similar to the first group with regard to inequalities, this group sees the short-term nature of such cycles (referred to as short termism) as major constraint. Biophysical attributes don't appear to be of concern, neither does a bridging, polycentric governance body. The landscape specific trial appears to focus on the actionable components of the generic trial. For example, an 'absence of credible and legitimate spatial planning' is mitigated by 'capacity building' and 'reaching consensus over goals' and boundaries (S1 Table). A prominent part of the current development issue cycle relates to community access rights to local resources and therefore many institutions are involved community mapping. In Indonesia, social forestry and the transfer of 12.7 million ha of state forest to local ownership exemplifies this trend [74]. The low ranking of inadequate data on market risks might represent tendency for community development groups to preferentially avoid market-driven approaches to development. The perspectives in this group come from a mix of international researchers, Indonesian

Fig 3. Q-statements and their z-scores for the general trial. Ordered from most distinctive at the top to most consensus at the bottom (based on z-score differences). Distinguishing statements that defined each discourse are found in S1 Table of the supplementary material.

Fig 4. Q-statements and their z-scores for the landscape specific trial. Ordered from most distinctive at the top to most consensus at the bottom (based on z-score differences). Distinguishing statements that defined each discourse are found in S1 Table of the supplementary material.

https://doi.org/10.1371/journal.pone.0211221.g004

researchers and civil servants. The civil servants in this group represent local levels of government, rather than centralized agencies.

Group 4. Integrationists. This group sees that the main obstacle to landscape functionality is governance incoherence. Specifically, bureaucratic politics inhibits holistic management (see Sahide, Supratman (71)). They see structural issues in the form of organizational silos leading to incoherent governance from overlapping or conflicting regulations from different actors. The premise for this argument is that if organizations coordinated their efforts, then collaboration between sectors at different levels would mean more effective management. This falls in the domain of political scientists and social-ecological systems theorists who plea for effective polycentric and multi-level governance arrangements [75]. Note that 'no space for a management institution that integrates. . ..', is not a problem; in Indonesia there are indeed legislated institutional platforms for integration, such as Forest Management Units that aim to coordinate sectors for integrated management [30, 76]. The lack of clarity of land use categories, user-rights and accountability exemplifies the lack of effectiveness of these institutions due to contested power and unclear authority. Integrationists consist of international and Indonesian researchers.

General trial group 5. Democrats. The democrats, a discourse that only emerged in the general trial, are generally unsatisfied with democratic institutions. Lack of transparency and accountability to civil society is primarily a concern of democratic responsiveness [77]. The democrats do not see the rapid change of policies or short termism as a problem, nor election-cycle politics, likely because that is a function of responsive democracy. Their primary concerns for inconsistencies between sectors and poorly harmonized governance structures distinguish them from the social exclusionist discourse. Democratic functionality does not mean inclusively delivered benefits as there are by definition, winners and losers, and as such their primary concerns do not reflect social exclusionary processes. Their concern about inconsistencies, within one administration, means the government does not effectively govern. This discourse suggests that democratic representation by governing bodies will allow for landscape interventions to be allocated in ways that satisfy place-based needs. The democrat discourse came from Indonesians in academia.

Specific trial group 6. Neoliberals. The neoliberals see landscape sustainability being constrained by corruption and unpredictable regulatory environments. Markets and trade don't inhibit landscape functionality, rather the influence of markets and trade should benefit from trustworthy trade and regulatory agreements. The pressure on land and resources guiding government priorities is the major constraint, but rather than regulations and enforcements needing to increase landscape functionality per se, predictability in the regulatory environment is highlighted. Roads and their enabling characteristics for market access and niches are of little concern, either because they are seen as already existing or are public goods to be encouraged. The limits to functional landscapes are therefore related to excessive intervention at the top. The neoliberal perspectives came primarily from Indonesians, comprised of a mix of civil servants, academics and researchers.

Consensus

For the landscape specific Q-sort trial, there was consensus among all participants over three statements (Table 2). Overall, a constraining element was related to democratic governance. The participants agree that for landscapes to function, especially when thinking about the local contexts of their own landscapes, transparency and accountability to civil society are major hindrances to landscape functionality. An overall lower constraint on landscapes, with local context in mind, was the transition of unconnected poor people to active participation in

Table 2. Consensus statements from the landscape specific trial.

	No	Statement	Score
Consensus statements (do not distinguish between any factors)	8	Lack of accountability to civil society, opaque decision making, lack of transparency	2
	14	Slow transition from subsistence focus to active participation in wider landscapes	-2
	22	Overlapping partly contradictory laws with loopholes and lack of grievance procedures	0

socio-political economies via connectivity to the outside world. This may represent perceptions that there are no more strictly subsistence livelihoods, or that people are already connected through their social ties beyond the local confines of their livelihoods. Another possible argument is that people shouldn't have to transition from a subsistence focus to have active participation in the landscape, that landscapes should be inclusive of people whether they lead subsistence-based livelihoods or not. Surprisingly, participants agreed that overlapping and contradictory laws sit neutrally for landscape functionality. This seemingly contradicts what many scholars point out as being fundamentally problematic for Indonesia's state capability: a complex and ambiguous legal framework [78–80].

We conceive all six discourses as different vantage points of a thematically similar constraint—poor governance. Considering the epistemological and ontological differences among diverse practitioners and academics, one might have assumed that discourses might have aggregated around different domains in the natural and social sciences. Instead, the narratives are all based on different politically situated vantage points of how institutions govern and influence socio-economic development outcomes.

Discussion

At the beginning of this paper we suggested that the broad range of understandings of a landscape approach implies that implementers are likely to diverge in their perspectives as to what the obstacles are for landscape functionality. To a degree, our results suggest otherwise. A governance leitmotif runs through the overall results and discourses. This suggests that of the many applications and contexts in which they are used, the motivation behind landscape approach implementation is perceived ubiquitous governance failures. However, the overall differences between ranks for 'generic' Indonesian landscapes and 'specific' landscapes represents fine-tuning of generic perceptions to local contexts.

Local contexts

Four discourses were similar between the generic and specific trial, with minor but noteworthy differences. Every discourse contains statements that are actionable at the landscape scale, and indeed landscape approach efforts have tried to address them. In addition, the discourses contain exogenous issues that originate at national and/or global scale and require coping mechanisms rather than efforts to modify underlying causes. Although four discourse titles remained the same for the generic and specific trial, the distinguishing statements changed in ways that appear to distil problems into actionable focus items. We see that the general trial discourses favoured statements that are more problem-definition based, and items actionable by organizations are more prominent on the specific landscape trial. For example: in the" seeing like a community" group generic landscape trial, statements such as 'unequal bargaining power', 'absence of credible planning', and short termism were deemed to be most problematic.

However, the corresponding discourse in the specific landscape trial highlighted what many NGOs working in community development do to address these challenges, such as capacity building, consensus building, and trust building [72, 81]. This highlights how participants mentally adjusted from generic problem framing to actual practitioner activities on the ground when moving from generic landscape issues to local contexts.

Statement 23, "increased pressure on land and resources leads to government priorities for economic growth over environmental integrity", appears in the list of main constraints for the landscape specific trial, and is a more environmentally focused statement than any main constraint in the general trial. The evolutionary origin of landscape approaches is associated with more strictly environmental conceptions of 'ecosystem approaches' [23, 82]. But, considering the iterations and evolution of integrated approaches to reconciling conservation and development, it is logical that previous lessons learned have steered conversations toward how governance obstructs management of social-ecological systems [30, 75, 83]. The perception that local demands and priorities collide and contrast with global environmental concerns is shared by others [84], and this is where landscape management strategies must mediate solutions. Management coalitions are needed such that the focal point of landscape governance moves further from simplistic global discourses such as climate change and biodiversity towards a more complex and nuanced approach that responds to the realities of all landscape equity holders and their demands on the landscapes [59].

Other statements that increased in rank of constraints when considering specific landscapes, were; (18) the rapid change of regulations, (30) limited local human capacity, and (10) inaccessible data on economic risks. Scores for the inadequacy of democratic institutions, overlapping laws and corruption became less constraining. This may represent the personal experiences people have with leaders and decision-makers in their own places. The motivation to set aside issues of corruption might displace generic ideological principles when project implementation depends on working with local stakeholders and their pressing needs. Focusing on actionable ways to build civil society seems to be more attractive than tackling institutional failures head-on via rule of law when governments are often the arbiters of legality and have vested interests in maintaining the status quo.

Short termism is only identified as a major constraint by those belonging to the community development discourse. Previous critiques in the scholarly community management discourse identify short termism as a major obstacle [85]. Short termism may be inherent to development, as institutions are entwined with democratic election cycles and the associated donor project-cycles, but might be more problematic now due to "whack-a-mole" policy reactions emerging from rising populism [84]. Global pressures are emerging from populist 'issue-cycles' [27], some of which are propelled by policy elites, who have little knowledge of the concerns of communities struggling to survive in the face of economic disadvantage [86].

Advancing landscape narratives

Critics of landscape approaches claim they are being used to de-politicize the problems apparent in social-ecological systems and entrench neoliberal exclusionary development [22, 23]. In the emergent inadequate governance narrative of our study, the largest discourse group, the social exclusionists, share similar concerns. They see inequitable and exclusive development outcomes as the biggest hindrances to landscape functionality, in the context of sustainability. The landscape approach experts and implementers that comprise that discourse group are not de-politicizing landscapes, rather people and their political institutions are prominent in their problem-framing of landscape approaches. As such, the largest discourse group, the social exclusionists, see problems similarly to how critical development theorists describe problems,

such as the exclusionary 'accumulation by dispossession' mode of neoliberal development [87–89]. It is clear that landscape approach academics and practitioners in our study are concerned about the inequitable outcomes of current neoliberal modes of development.

But, one discourse group emerged with neoliberal characteristics, comprised of primarily Indonesian nationals who see legitimate needs for a predictable regulatory environment that stimulates economic development through competitive markets and infrastructure connectivity. This mode of development is often criticized in the scholarly literature [47, 90]. Those critiques of development outcomes in Indonesia often come from western scholars who have relatively less at stake in Indonesia's national development processes [42]. Numerous Indonesian scholars have perceived the value of industrial cropping systems, such as oil palm, differently to critical human geographers of the west [47, 91, 92]. We see value in a tool like Q-methodology in exposing the varying views for better collaborative problem-framing. If our Q-methodology was done with more local forest dwellers it would have likely changed the results. We were not implementing change and did not have stakes in the local landscape development processes. But we are suggesting that if implementing agencies were to intervene in development processes in landscapes, they should account for these views transparently, with a relatively objective tool like the one explored in this paper. Management coalitions, which are described as crucial to the effectiveness of landscape approaches, must not overlook or discount those with different perceptions, especially locally, when trying to advance inclusive development or achieve conservation and development wins [59].

In our study, Indonesians represented actors implementing management decisions, interacting frequently with stakeholders across scales and with local communities. From our results, they hold a wide range of political viewpoints on the major constraints of landscape functionality. The wide range of views show that landscape interventions are subject to multiple knowledge systems, requiring different approaches to building consensus on moving forward. *Mushawara* (community meetings and discussions) are central to Indonesian conflict resolution and collective decision-making processes. Q enables both external people and locals engaging in landscape level *Mushawara* processes to transparently reflect on the differences in perspectives and engage explicitly with opinions that they might deem inappropriate or unexpected [61]. In Indonesia, inclusive *Mushawara* processes are indispensable for reaching consensus over landscape goals and the strategies taken to reach them.

All participants, regardless of their associated discourse, made it clear that reaching consensus among all stakeholders must be a priority, and that it must take place in a forum of mutual-understanding and respect. Coordination among landscape approach implementers will be easier if common concerns are the entry points for their activities. We think analyzing perceptions of landscape implementers and stakeholders with tools such as the Q-methodology adds transparency and helps make theory of change assumptions more rigorously explicit. [2] contend that scenario modeling [93] should be used to make landscape theories of change assumptions explicit. First, landscape approach implementers must clarify points of consensus and divergence among landscape stakeholders. Then they might make progress towards finding the overlaps and differences in their knowledge systems for finding common-concern entry points. And while the primary concerns—corruption, transparency and accountability— are not easily dealt with by landscape level initiatives, they must be part of the main strategic intents for any landscape-scale theory of change otherwise, interventions risk being displacement activities [94]

The challenges of social-ecological systems are complex and often stem from poorly coordinated decisions, where different elements of society frame problems in terms of their own needs and aspirations, leading to unsatisfactory, and often conflicting, zero sum outcomes [7, 30, 31]. Underlying this, is that knowledge is often contested between multiple actors in

complex landscapes [27, 28]. In their study on the importance of perceptions on natural resource outcomes, Howe, Corbera [95] demonstrate that actors' perceptions underpin their policy and management positions, and that policy and management is more likely to fail if their positions mask conflicting values. Landscape stakeholders have a shared responsibility to retain the multi-functionality of landscapes to service future generations and science must contribute to the knowledge, capacity, and motivation for them to do so [62, 63]. If implementers of landscape approaches are going to succeed in achieving their goals, they must come to grips with the actors and discourses at multiple scales; problem framing must be rigorous and collaborative [29]. Recognizing and addressing the diversity of perceptions and discourses of people in a landscape allows for landscape management coalitions to collaboratively problem frame. This should help avoid decisions that do not reflect the values and perceptions of stakeholders in the landscapes that may otherwise provoke conflict or delay success in achieving landscape sustainability [34, 84].

The richness of concourse (Fig 3) around the landscape approach and its prospects for sustainability confirms some conceptual 'capaciousness' [18]. The range of terms and concepts enables divergent vantage points in pluralistic societies like Indonesia and in transdisciplinary approaches to problem-driven sustainability science. But we find that landscape approach is not a singular 'management ethic' [18]. Rather, political perspectives exist along a spectrum of ethically-bound 'logics of appropriateness' [96] for how landscapes should be governed. And while the overall consensus is that corruption, transparency and accountability are seen as the ultimate obstacles, poor governance is encapsulated by a variety of discourses and viewpoints within the landscape approach community. Understanding and making the various vantage points transparent helps landscape approach practitioners to harmonize their efforts with local conceptions of the problems [84].

Conclusion

To achieve sustainability, landscape approach implementers must understand the comprehensive range of narratives of the problems that they aim to solve. "Policy emerges in a complex process where opinions and concepts matter at least as much as objective evidence, if the latter exists at all" [52]. In this paper we provide evidence that a diverse group of landscape practitioners and researchers have common concerns- that poor governance constrains landscape functionality in Indonesia. The evidence also shows that there is variation in the discourse, depending on the values that underpin one's political vantage point. Landscape approach implementers must grapple with divergent political vantage points when striving for consensus on the theories of change for landscape development trajectories. As landscape approaches to achieving sustainable development become more prominent in Indonesia and among international agencies to achieve sustainable development, researchers and practitioners must focus on the key obstacles if they want to achieve impact. The results of our discourse analysis show that there are numerous angles from which landscape sustainability is seen to be obstructed by poor governance. We identified six discourse groups among our participants: (1) social exclusionists, (2) state view, (3) community view, (4) integrationists, (5) democrats, and (6) neoliberals. Overall, corruption, transparency and accountability are perceived as the major constraints on landscape functionality. If landscape approach implementers do not address governance issues of major concern and grapple with their own political differences, then interventions risk being displacement activities [94]. Theories of change for landscape approach initiatives must incorporate strategies to account for political stances among landscape stakeholders and rectify governance failures. Only then will sustainability be within sight.

Supporting information

S1 Table. Discourse factors and their defining and distinguishing statements for the general and specific trial. The top 3 'most agree' are landscape constraints, bottom 3 'least agree' are classified least important. Any statement scoring a|3| that was flagged as distinguishing (D = P < .05 and D* = P < .01) is included to add richness to the defining characteristics of the discourse. General trial results on left compared to landscape specific trial results on right. The same discourses arose and are labelled in bold along the left vertical axis. At the bottom are two diverging discourses between the generic and specific trial. Underlines highlight thematic traits defining the discourse type.
(DOCX)

S2 Table. Discourse analysis for the general trial. Statements ranked 'most agree' to 'least agree' for each factor. Each factor represents a discourse type. Z-scores determine statement rankings and are the squared differences among from the P-set community flagged for each factor.
(DOCX)

S3 Table. Discourse analysis for the landscape specific trial. Statements ranked 'most agree' to 'least agree' for each factor. Each factor represents a discourse type. Z-scores determine statement rankings and are the squared differences among from the P-set community flagged for each factor.
(DOCX)

Acknowledgments

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Chapter 2: Comparative development benefits from small and large scale mines in North Sulawesi
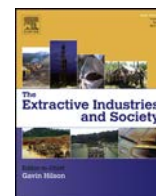
Original Article

Comparative development benefits from small and large scale mines in North Sulawesi, Indonesia

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ABSTRACT

We assess the opportunities and threats posed by small and large-scale mining in Eastern Indonesia. Here, both activities coexist in one landscape: in the Bitung and North Minahasa Districts of North Sulawesi. Each is associated with different development pathways. Both scales of mining have been controversial and are criticized for their environmental and socio-economic impacts. Small-scale mining contributes more to the local economy encouraging local entrepreneurship but yields a lower total financial return. Large-scale mining provides better job security and safer working conditions for employees, but any benefits of capital transformation do not accrue locally. Policy should focus on the formalization of small-scale mining and pay closer attention to the impact of large-scale mining on local communities. The governance of both scales of mining would benefit from a 'landscapes approach' to negotiating conservation and development trade-offs.

1. Introduction

Mining can be an important driver of economic growth in many developing countries. There is growing consensus, however, that society must manage mining to catalyze broad-based economic development whilst simultaneously achieving maximum social and economic benefits (United Nations, 2012). Yet concerns remain about negative environmental and social impacts (Harvey, 2013; Wan, 2014). A UN task force is in the process of assessing mining's developmental impacts, both positive and negative, from which indicators may be developed for inclusion in the upcoming sustainable development goals (SDG's) (The Mining Working Group 2014). This task force stresses the need to focus on issues of sustainability, equity, governance, and poverty alleviation. However, the industry is not homogenous and this range of issues requires implementation of a suite of different policy approaches

depending on the political, social, economic, and environmental context (Intergovernmental Forum on Mining, 2013).

Many studies have analyzed how large-scale mining and artisanal and small-scale mining (ASM) affect people, their institutions and their environments (Tschakert, 2009; Hilson, 2012). In North Sulawesi, as elsewhere, large-scale mines are criticized for their negative environmental impacts and are portrayed as contributing to corruption and weak governance (Jennings, 1999; Tambang, 2010). Artisanal and small-scale mines (ASM) are criticized for their poor health and safety records and their contribution to pollution (Aspinall, 2001; Limbong et al., 2003). Here we use ASM loosely as a label for rudimentary mineral extraction and processing activities, feature manual labour, and are often characterized by hazardous working conditions with frequent negative human and environmental health impacts (Hilson, 2002).

Although previous studies provide an overview of economic, environmental, and other social impacts, few compare and contrast local outcomes of the two scales of mining within a single landscape. This paper helps to bridge this gap by examining the contribution of large-scale mining and ASM industries to

sustainable development in the Bitung and North Minahasa Districts of the North Sulawesi Province, Indonesia. Development is moving east in Indonesia, and the default business models pertaining in the west pose a threat to the finer scale of cultural and biological diversity characteristic of the east (Margules et al., In Press). We studied the landscape around a large-scale gold mine, and a cluster of small-scale mines in a single landscape (Sayer et al., 2013). International corporate backing funds the large-scale mine. The small-scale mines utilize much simpler technologies sponsored by local businessmen. We analyze the contribution made by the different mining types to development and consider how policy makers can better address development in the context of mining to achieve more sustainable outcomes. For this, we compared the mining types to determine their impacts on local communities, their sustainability and their impacts on equity and governance. We provide results to support a conclusion that decision makers should approach the governance and management of small-scale mining and large-scale mining based on evidence that is locally contextual and just. According to our study, landscape approaches offer ways to address these challenges. One conclusion challenging the status quo is that Indonesian small-scale mining brings sustainable prosperity to local people and yet is unjustly marginalized in policy processes, in comparison to large-scale mining. Another conclusion in need of further exploration is that both models might sensibly co-exist and can contribute in different ways to achieving sustainable development goals. Indonesia is a relatively young country still in the process of determining land rights and governance arrangements. Its regulatory frameworks, therefore, should address the needs and opportunities provided by all scales of mining.

2. The Indonesian development context

Comparative economic and geopolitical isolation has, until recently, protected Eastern Indonesia from some of the major investments in land-based industries that have transformed Sumatra, Kalimantan, and Java at great environmental and some social cost. Due to its relative isolation, Wallacea[1] has some of the highest levels of poverty in Indonesia. Scores on Millennium Development Goal indicators are low – the Human Development Index ranks Eastern Indonesia below Java and other Western Indonesian provinces. However, major spatial development plans issued by the central government, and continued economic growth is moving development east (Nurmandi and Purnomo, 2011). As the people of Eastern Indonesia anticipate this development push, they face great opportunity along with great risk: opportunities to raise living standards and increase prosperity, a prerequisite for the successful sustainable management of natural resources, and risks in the form of inequitable exploitation of natural resources, environmental degradation and marginalization of culturally diverse, but poorer groups of people (Margules et al., In Press).

Mining activities in Indonesia are currently governed under the 2009 Mining Law. This law regulates both local and foreign investors and was intended to increase the ease of doing business. In 2013, a new indigenization law was put in place that limits foreign ownership to 49% with the goal of increasing the benefits of mining for Indonesia. In 2014 another law came into effect, which requires all primary commodities, including raw minerals, to be processed within the country before export, a deliberate attempt to avert Dutch Disease, the tendency of resource booms to be detrimental to the manufacturing sector (Winzenried, 2014). These changes reflect the government's perception of the development opportunities presented by the growth of the large-scale mining sector. Large-scale mining contributes 12% to

state GDP (Indonesia Mining Report 2013) and economists expect the value of the industry to grow at an annual average rate of 10.0% from 2012 levels, from an estimated US$93.4 billion to US$153 billion by 2017 (Indonesia Mining Report 2013).

Large and small-scale mining models contribute differently to economic development and as such they receive different socio-political treatment. In general, institutions and society prioritize large-scale mining and marginalize small-scale mining. In Indonesia, small-scale mines are often characterized as "illegal" (Spiegel, 2012a,b). However, some local authorities are beginning to subject ASM to oversight and regulation, a process termed "formalization" (Siegel and Veiga, 2009). The illegality stigma partly results from the failure to recognize poorer groups' resource rights (Spiegel, 2012a,b). Development agencies endorse neo-liberal forms of capital investment and in line with this, all levels of the Indonesian Government tend to welcome large-scale mining (World Bank, 2001; Deininger, 2003; Harvey, 2007; Indonesia Mining Report 2013). Large-scale mines are subject to much more national and international scrutiny, but are controversial because of the rent-seeking behaviour associated with them at higher levels of government (Sachs and Warner, 2001). Their sustainability has undergone progressive redefinition to the extent that use of the phrase "sustainable development" in the mining sector now refers primarily to their sustained economic performance (Negri, 1999; Kirsch, 2010). The industry brings financial benefits to investors and to government agencies but not necessarily to local people.

Attempts to remedy this are often made through Corporate Social Responsibility (CSR) programmes. However, CSR is often criticized for having done little to contribute to the betterment of local communities (Slack, 2012; Harvey, 2013). In the case of Eastern Indonesia, the flow of benefits is particularly problematic because the 'elite with expertise' designing such programmes are geographically far removed, based in the capital Jakarta, where they make decisions that are not necessarily best suited to conditions in the east. International development agencies justify their support of large-scale mining because of its potential contributions to downstream economic development (i.e. that locals will benefit). However, rhetoric and reality differ because capacity asymmetries at local scales result in unheard community voices. The formalization of ASM faces similar problems, but at more local scales (Ferguson, 2007; Spiegel, 2012a,b). Because of its local focus, ASM, alongside large-scale mining, might play an important role in reconciling the conservation and development trade-offs unique to Eastern Indonesia.

The irregularities and complexities found within Indonesia's ASM sector provide the context for this paper. A study of small-scale miners in Central Kalimantan showed that changing government structures, regulations, and policies have led to the marginalization of workers who are classed as 'illegal miners' (Spiegel, 2012a,b). Although many small-scale farmers hold 'People's Mining Licenses', political leaders and authorities describe 90% of small-scale mining in Indonesia as illegal (Aspinall, 2001). This stems partly from a disconnect between the centralized federal and highly decentralized local governance structures. Attitudes and beliefs held among ruling and wealthier classes demean the social standing of the informal mining sector and culture. This has been described as an imposition of structural violence against marginalized, 'poor' groups of people who are doing what they can to survive (Spiegel, 2012a,b). This group is not small, as conservative estimates suggest that there are 77,000 informal mines employing up to 500,000 people (Jennings, 1999). Previously, Indonesia's Central Bureau of Statistics determined that small-scale 'informal miners' outnumbered formal mine site employees by a factor of at least 10–1 (Spiegel, 2012a,b). These numbers are outdated and probably underestimate the current situation, as mining has grown rapidly over the last decade. District

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[1] A label for Eastern Indonesia's islands.

level governments attempt to manage this by granting community-mining permits. Yet their efficacy has not been analyzed, and there is no standard to which they are held accountable, and central government capacity may not be adequate to address environmental, economic, and social concerns.

Mining in Indonesia, in all of its forms, has significant environmental impacts (International Mining for Development Centre 2013). The WWF claims it is the next big threat to high conservation value forests, following the poor practices of logging companies (Simamora, 2010). UN assessments suggest that Indonesia's ASM sector releases more mercury into the environment than any other country, apart from China (Jennings, 1999). The problems associated with mining are now widely recognized and Indonesia engages with a number of international initiatives such as Publish What You Pay, The Extractive Industries Transparency Initiative, Mining for Development, and the International Council on Mining and Metals in a effort to achieve better stewardship of its mineral sector (Indonesia Mining Report 2013; International Mining for Development Centre 2013; Winzenried, 2014). These initiatives aim to enhance governance such that poor people experience the benefits of large-scale mining. To address issues relating to ASM, formalization is the inevitable policy route, but this requires careful consideration of the local context and might benefit from evidenced-based case studies such as the analysis reported here.

3. Methods

We compared two locations, one cluster of ASM sites and one large-scale mine site within one landscape in North Sulawesi, over the course of 2 months, between August and October 2013 (Fig. 1).

We visited the mining operations and their surrounding villages and asked miners and non-mining villagers to complete simple questionnaires. This was done in Tatelu for the ASM, and in Batu-Putih Atas, for the large-scale mine site ($n = 40$ (6 ASM operators, 7 villagers in Tatelu, 6 large-scale miners, 21 villagers in Batu Putih Atas)). We interviewed key actors, including mine site managers, heads of villages, local tour guides and elderly people with historical knowledge. We located all survey and mine sites on Google Earth® imagery. The spatial resolution of the images is ± 5 m and images date from 2011. We made *in situ* observations to ground-truth the features, both physical and social, on the maps. This data was manipulated using ArcGIS.

3.1. Site description

The ASM sites are located in the Tatelu region, situated 35 km northeast of Manado city, the capital city of North Sulawesi Province (Fig. 2). The mines lie within the Talawan Watershed, which drains from the peak of Mount Klabat (1995 m) towards the western coast of the peninsula of North Sulawesi. Two rivers, Talawan and Bailang, flow through the ASM sites. In Tatelu, land use is characterized by mixed agroforestry dominated by coconut palm trees interspersed with some intensive farming (including fish ponds), and human settlement. The gold mining here occurs adjacent to human settlements, with farming and mining taking place side by side. Prospecting by an international company, Aurora Gold, led to the discovery of gold-bearing quartz veins in the Tatelu mine site in 1997.

Within a year local people and migrants from elsewhere in Indonesia began dropping shafts, extracting and processing the
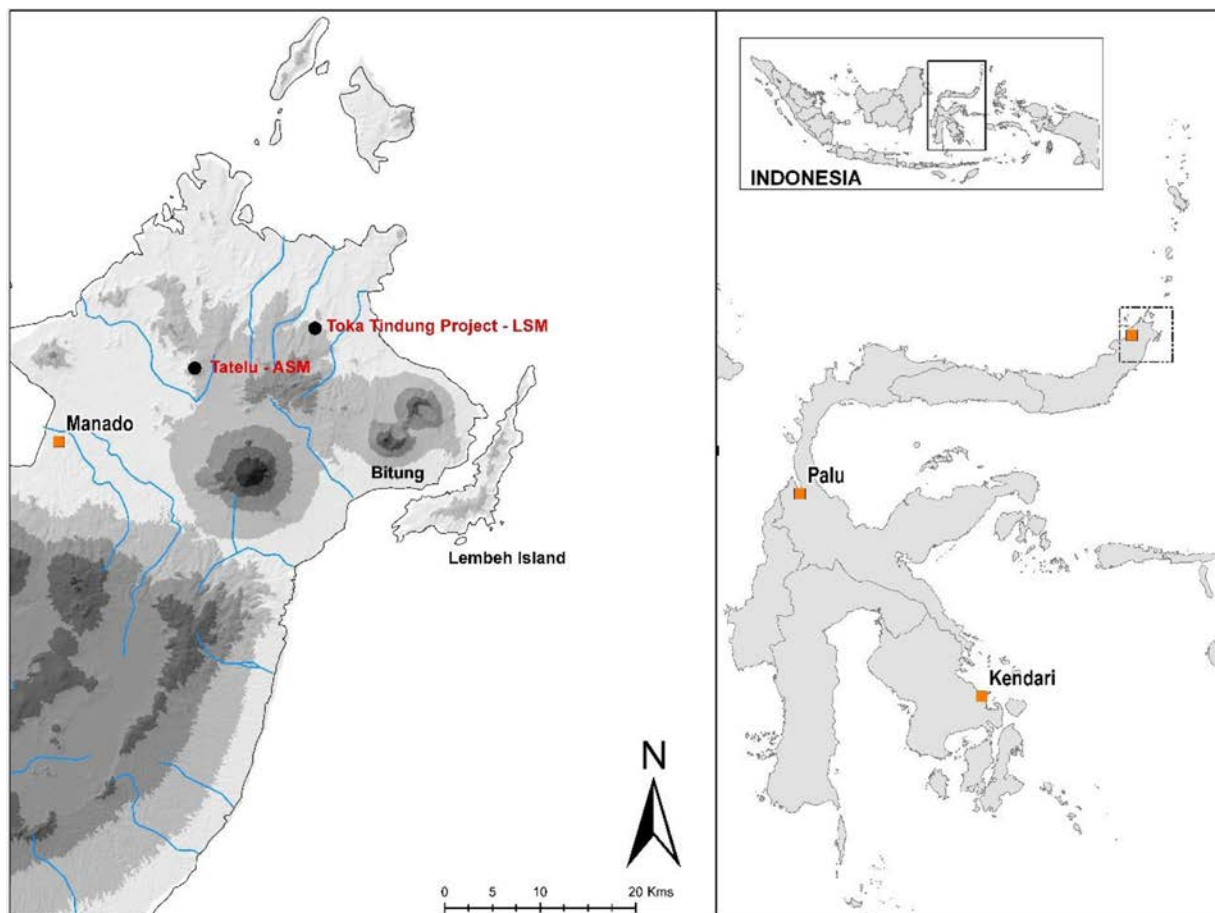

Fig. 1. Study site locations: Tatelu, home of the ASM activities, and Toka Tindung, the large-scale mine site. Inset shows study site location within Indonesia.
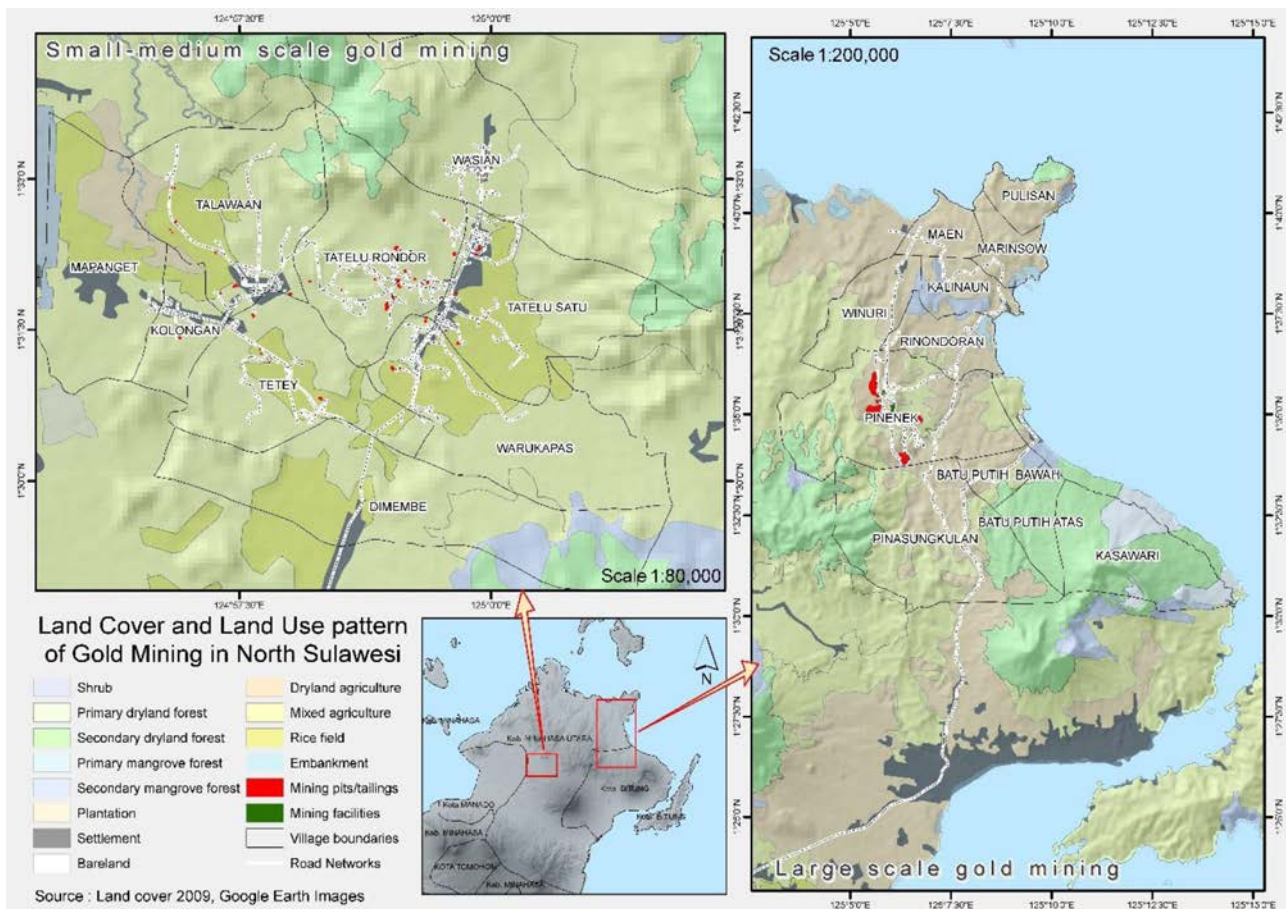
Fig. 2. Land use patterns and gold mining distribution at two sites. ASM is integrated into the human settlements and large-scale mining is isolated from surrounding communities.

ore. Experienced small-scale miners from elsewhere in Indonesia introduced technology to the area. Conflict linked to drug and alcohol abuse, prostitution, land disputes, and gambling, soon arose between the locals and migrants. By 1999, local people had organized a militia under the lead of a local *preman* (a power figure), and began forcibly removing migrants. Personal safety became an issue in the area and for the next 3 years the five surrounding villages organized themselves to handle these security and social issues. Local government granted authority to the PAM SWAKARSA (local security force coordinated by the head of village) to protect local interests.

In 2004, the head of village, with the support of local police-authorities, founded a cooperative. Known as Koperasi Batu Emas, it is now the main institution governing mining in the area, which has grown consistently since 2005. Many people have migrated to the area from South Sulawesi, and as far away as West Java. These people operate under the control of the local cooperative, to which they pay contributions. Migrants are eventually deemed to be transplanted 'locals' and are accepted into the local communities, although this can take several years.

In the Tatelu area, ASM tailings can be seen on Google Earth Images. Some are located in, or adjacent to, farmed and abandoned paddy fields. The gold mining area encompasses seven villages: Talawaan, Wasian, Tatelu Rondor, Tatelu Satu, Dimembe, Tetey, and Warukapas (Fig. 2). A community mining license (Wilayah Pertambangan Rakyat – WPR) issued by local government covers 50 ha – the entire available mining area. Currently, only 30 ha are exploited. The miners work gold-bearing quartz veins that are typically 10 cm wide and tens of metres long. They mine these

veins by sinking shafts up to 100 m deep, and they then follow the veins laterally to form a web-like network underground. Ore is extracted by hand and hauled in bags, each weighing 50–75 kg. Veins occur in clusters, as do the mine workings. Individual groups have control over a small area of land containing one or several mineralized vein systems. The ore grade cut-off for profitability for ASM is approximately 5 g/t. By following the ore veins, ASM operators locate higher grades, averaging 7 g/t reaching a maximum of 12 g/t (Sulaiman, 2007). Fig. 2 illustrates the degree to which ASM activities are spatially correlated with human settlements.

The Toka Tindung Gold Project, operated by Meares Soputan Mining (MSM), is our large-scale mine site. It is located 35 km northeast of Manado City, and shares a similar geography. The Araren River flows through the largest open pit at that site. Human settlements no longer exist within the mining complex and security gates protect the area. Outside of the mine complex, large-scale coconut plantations dominate the landscape. The mining company must negotiate with private tree estate owners when it wishes to expand its mining operations. The mine is located within the boundaries of the city of Bitung, a major international port city, from which agricultural and fisheries products are exported. Adjacent to Bitung is the Lembeh Straight, an international ecotourism attraction, popular among divers for its richness in seahorse species. In the late 1990s, prospecting by Aurora Gold in what is now the Toka Tindung site fuelled the growth of ASM operations similar to those at Tatelu. When Aurora Gold secured a mining license for the site in 2000, locals were evicted from their land and all ASM operations were closed. Local people informed us that the head of

village was complicit in the purchase of land from the people and subsequently transferred it to Aurora Gold. Local people now claim that they received little payment for their land and that their Free Prior Informed Consent (FPIC) was not obtained. Our results will show evidence for the reported lingering resentment about the way in which the company colluded with the village chief to exclude local miners and take control of the mineral resources in the area. In 2002, Aurora Gold sold the Toka Tindung Project to Archipelago Resources Ltd., a company listed on the London Stock Exchange. Between 2002 and 2011 Archipelago began addressing social and environmental problems. Informants reported that the communities now have a more positive view of the mining operations (historical data from in-house documents at the Toka Tindung Site, and interviews with the sustainability officer and the General Manager of the mine site). Since 2011, the mine has been operating at full production and revenues per annum are around US$225 million. In 2013, Rajawali Corporation–an Indonesian company – acquired a 90% stake in Archipelago Resources. This exceeded the Indonesian Government requirement of 51% domestic ownership of mining operations. It made the mine conform to the current legislation limiting foreign ownership of mines.

The large-scale mining site consists of five relatively large open pits (500 m × 100 m), with another two planned. They are located close to Pinenek, one of the 13 villages that surround the mine site (Fig. 2). These villages are the residences of many employees at the mine and are the target of Corporate Social Responsibility (CSR) investments by the mining company. The mining company claims that 63.8% (443 people) of its employees come from the 13 villages surrounding the mining sites (only 11 villages are identified in the company's recent CSR report: Wineru, Maen, Winuri, Pulisan, Marinsow, Kalinaun, Rinondoran, Pinenek, Pinasungkulan, Batu Putih Atas and Batu Putih Bawah). This differs from its CSR reports, which claim that 75% of the labour force is local (Archipelago Resources PLC, 2012). The five pits are spread over an area of 40,000 ha. However, the company only has legal rights to approximately 1500 ha of this land. Extraction is much more environmentally invasive than at ASM sites. The cut-off grade is 0.5 g/t, meaning that large volumes of ore are extracted through open-cut pits. The land is clear-cut and large mechanical

excavators extract the ore. The company exercises complete control over its operations, and all settlements have been relocated. Large areas devoted to coconut monocultures, which are under local smallholder ownership, surround the concession. Locals have lost the right to use the land within the concession. The mine is currently projected to operate until 2027 (there are provisions to mine for 9 years and ore stockpiles for a further seven). The large-scale mine will therefore close long before the ASM operations.

Fig. 3 illustrates basic differences between the ASM and large-scale mine sites. The allocated area for the ASM is 50 ha. A variety of economic activities occur within this area. Agroforests and mine shafts are located in close proximity and are served by the same settlements and narrow roads. The amount of land alienated from local use is much less than at the large-scale mine site.

4. Results

The results of our study are summarized in Table 1. As is shown, economic outcomes contrast between the sites.

Fig. 4 highlights the connections among local stakeholders in the ASM area. The land provides multiple sources of income for local people, and the mines directly employ approximately 2000 people in mining and processing. An estimated 40% of the Tatelu's population is directly engaged in mining. Interview responses and observations showed that gold mining is the main economic driver in the area. Before the mining operations began, people were primarily subsistence farmers with agroforestry crops and some freshwater aquaculture. Markets and the number of entrepreneurs increased with the economic prosperity brought by gold mining. According to one local government representative:

"The mines here are harmonious and vital to the prosperity of our people, they are the centre of all economic activity, and that has allowed us to invest in our future. Without them we would remain poor farmers."

Survey responses show that ASM workers earn on average more, but with more variation compared to those who work at the large-scale mine (Fig. 5). The local community members who are
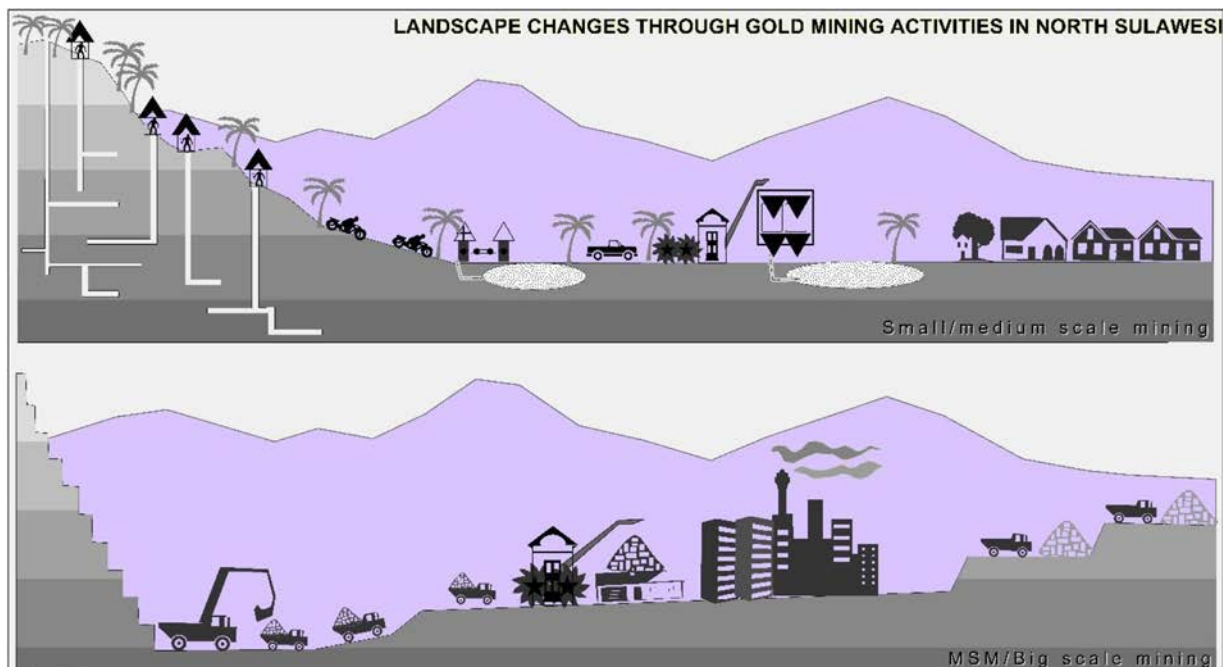

Fig. 3. Representation of the landscape profile around the two types of mining operations.

Table 1
Summary of the advantages, disadvantages and development impacts of different types of mining in the landscape.

Small-scale mines	Large-scale mines	Development critique
Profits retained locally	Profits leave community	ASM contributes more to community development
Asset conversion: local natural→local financial→local human	Asset conversion: local natural→foreign financial→unknown	Sustainability is contingent on the transformation of assets
Encourages local entrepreneurship	Creates sense of welfare dependency	Has implications for future community resilience
Embedded and connected to rest of landscape	Enclave	Downstream economic benefits are contingent upon this
High local participation	Low local participation	The communities voice in development outcomes is higher for ASM
Treated by locals with pride and ownership – high local transparency	Treated with suspicion – low local transparency	Transparency is a prerequisite for good governance
Enhances land tenure security	Weakens local land tenure	Part of the local formalization process for ASM; asymmetrical power and knowledge for FPIC in the large-scale sites
No job security	Better job security	Economic insurance can lead to greater productivity
Unsafe working conditions	Safe working conditions	Avert disasters and retain good human capital
Wages go to workers as cash	Wages go to wives in bank accounts	Less frivolous spending when money is in the female head of household's control
Some biodiversity retained	Reduces local biodiversity	Local prosperity is a prerequisite for successful conservation
Issues with governance	Accountable to international compliance standards	Enhanced formalization processes are necessary to address these issues

not directly involved in ASM activities at Tatelu hold strong positive perceptions about the benefits mining brings to the community. The unemployment rate in Tatelu is decreasing, as the flow-on effects of mining are creating market needs that can be filled by local entrepreneurs and labourers. Before the arrival of mining, agriculture and fishery management were the main sources of livelihoods. Gold mining has brought prosperity in the form of increased income, better infrastructure and increased market diversification to the village. The perceived benefits between sites are captured in Fig. 6.

By contrast, the large scale-mine site is highly mechanized and fewer people are employed in relation to the volume of ore
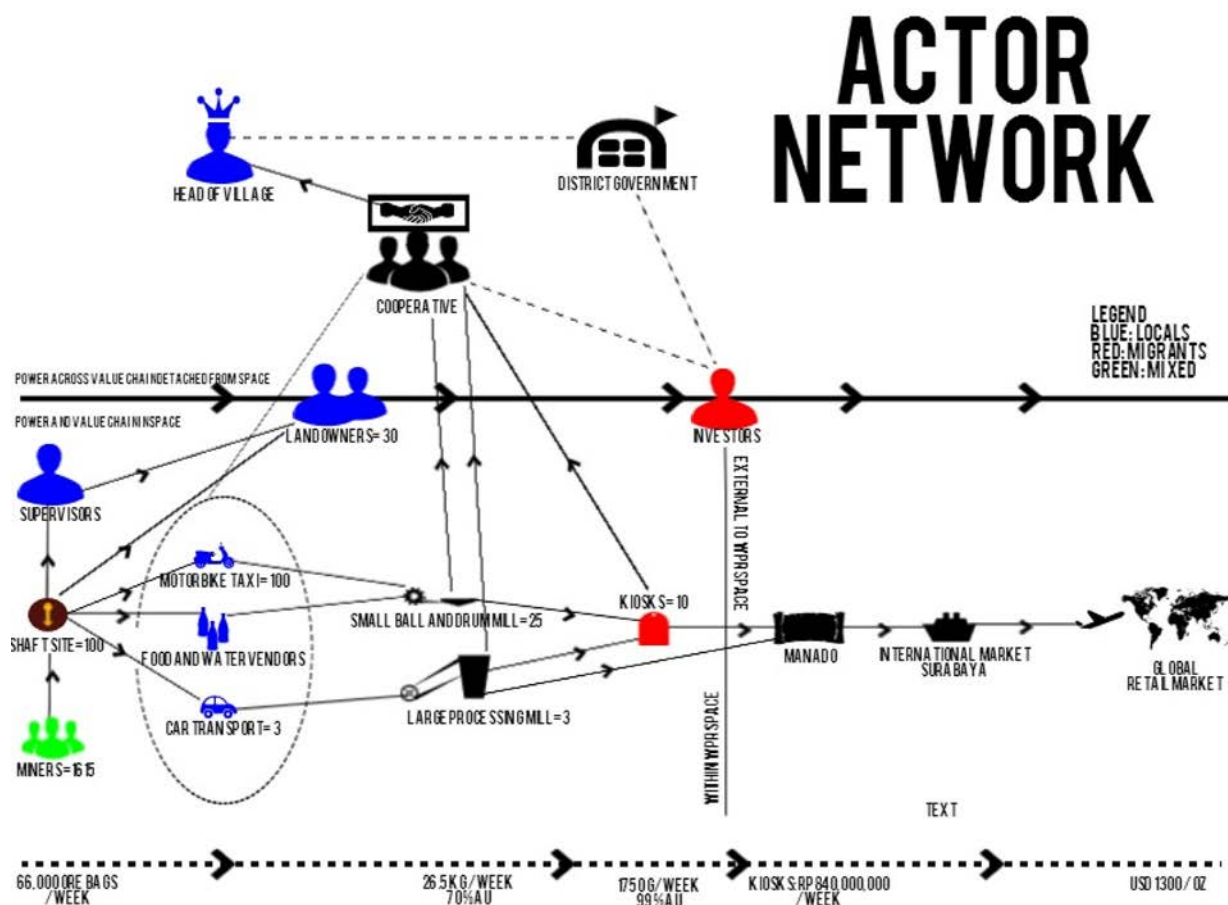
Fig. 4. Processes, people, and value in the small-scale mining actor network.
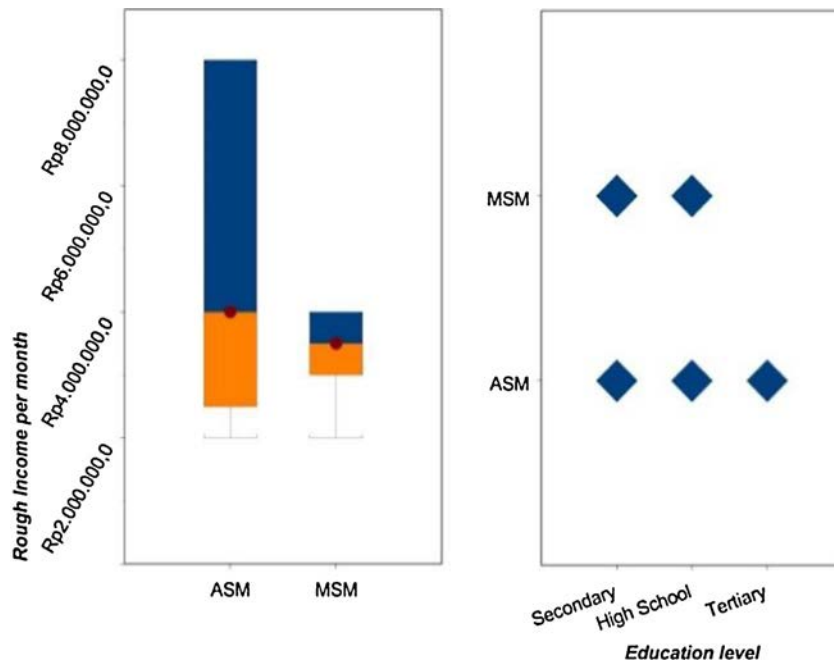
Fig. 5. Differences in income and education levels between workers in ASM and the large-scale mining company, MSM.

processed. Local economies are not significantly affected by the mining except through employment and CSR activities. There is also a risk that *ad hoc* payments made consistently by the company to local communities will create a sense of welfare dependency. As one manager at the large-scale mine explained in an interview, "*We have paid the religious leaders, the government officers, basically, anybody with local power, we must keep happy.*" There is relatively little impact on local enterprises because the mine exists as an enclave disconnected from local markets. Road development in the area has been driven by other activities, principally fish canning

and coconut processing in the neighbouring port city of Bitung. People benefit from the CSR schemes in minor ways, for instance through church renovations, public toilet construction, and selective investment into tertiary education. But for the majority of the people in the 13 villages that surround the site the large-scale mining operation only benefits the few who are employed. The majority of the benefits flow to investors who are based in distant cities or are international shareholders. The more skilled and higher paid positions on-site are fly-in fly-out employees based as far away as Australia and Turkey with no long-term
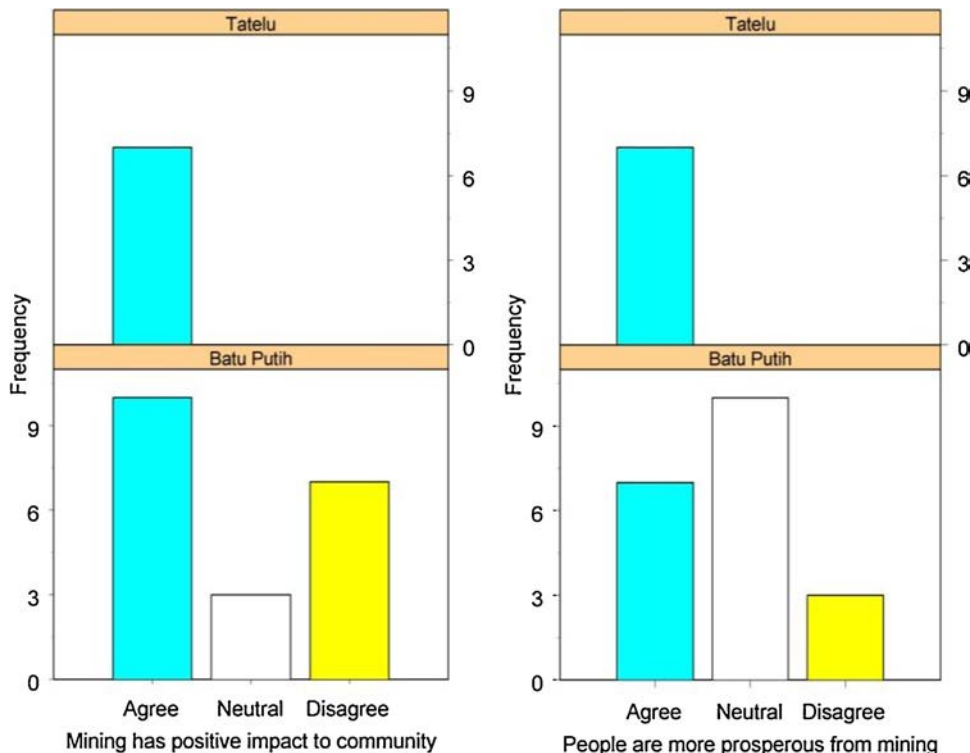
Fig. 6. Perceptions of mining activities at Tatelu (ASM) and Batu Putih Atas (large-scale mine).

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attachment to the area. According to the local community liaison officer:

"I don't know about the value of the gold they dig or who owns it. I don't know about where the money goes or where the gold goes. I don't know when the mine will close either. They ask me what the community needs, but then tell me what type of things they are willing to give. A man comes every month to tell me these things."

In Batu Putih, one of the 13 villages receiving CSR support from the large-scale mine, people have varied perceptions about the benefits that mining brings. Some are positive, some are neutral, and some are negative. The people who claim the company has brought negative impacts to the village tend to be of the view that coastal fish stocks are decreasing due to the disturbance brought by daily blasting in the gold ore extraction process. Socially, there are some tensions in this community, as people who do not find employment in the mine are jealous of those who do. According to a local fisherman:

"Some of my friend's children work for the mine, they are professionals. It has brought good income to their family, and I can't complain about that. But some of my friends are jealous that they cannot get jobs like the others."

There is an undercurrent of distrust towards the local authorities. Complaints include the suspicion that they are engaged in corrupt dealings and are not transparent in their knowledge of the mining operations and plans. According to a local historian and guide:

"People came in their helicopters. Thousands used to live like they did in Tatelu. And now there are open pits, and no more people. The one who benefited was the local leader, he was paid for access to the land and to move the people. Some lucky people are employed, but our land is suffering. The trees are dying and the fish stocks are declining. The bombing and the waste are to blame."

Education within the ASM community is more varied than in the large-scale mine feeder villages (Fig. 5). The ASM activities not only attract less-educated people, but also certain individuals with tertiary education who are attracted by the high incomes offered in the mines. One respondent was a qualified architect and another a banker from Bali, both of whom reported that ASM provided more income and job security than they could obtain elsewhere. These cases are common according to our local informants.

Conversely, the local people who work for the large-scale mine have mainly graduated from high school but still work primarily as unskilled labourers. Their income is typically less than IDR 5 million (US $500) per month. However, working for the company has additional advantages such as health insurance and income security. As noted earlier, a low proportion of villagers are able to access jobs with the large-scale mine, compared to the high level of involvement at the Tatelu ASM site.

A combination of prior development attention, capital accumulation, stronger governance, and a closing of technological gaps, is starting to remedy the social and environmental issues that typically earn ASM operations a bad reputation. The head of the village in Tatelu maintains security. Interview respondents confirmed that all operations in the mining area require approval from the head of village. Security agents were not visible to us as visitors but people appeared to feel safe and reported paying 'security fees' to the head of village for his 'protection' against conflict and theft. Local concern at the level of mercury led to the intervention of the UN's Global Mercury Project. The United Nations Industrial Development Organization (UNIDO) dispatched a team to "teach miners cleaner and safer methods" for improved

environmental performance. They were refused access because, according to their report, there was a conflict between Archipelago Resources Pty Ltd. and the local ASM operators. The District Mining Ministry permitted some public health awareness campaigns, but did not allow actual onsite inspection or capacity building. However, our interviews suggested that the reason for the failure of the UNIDO team to penetrate Tatelu had to do with the power structure and the interests of the community. There was no reference to conflict with Archipelago Resources Pty Ltd.

The land on which ASM is operating now forms part of the WPR – the community-mining license, granted by the district government. Ownership is not contested by Archipelago Resources. The real reason for denying access to the UNIDO team was reluctance to allow outsiders to observe the mining operations over fear of disrupting the status quo. The same head of village granted us access to the site for the purposes of this study and claimed that he recognized the value of better understanding the socioeconomic benefits of ASM to local people. Locals, even when they are not involved directly in mining activities, report no environmental or health problems as a result of mining (Fig. 7). The miners themselves have shifted from using mercury to a cyanide system of extraction, and the earlier problems with mercury contamination now seem resolved. Local capital accumulation enabled the purchase and construction of these cyanide extraction systems, in addition to investment from some Chinese businessmen based elsewhere in Indonesia. The tailings from mining activities are stored in ponds and not disposed of directly into the river systems, which feed the freshwater aquaculture ventures in close proximity downstream.

Our observations on health differ from people's perceptions. We observed a lack of work-place health and safety practices and gruelling work conditions that could lead to deleterious health outcomes. There are no on-site health facilities in the case of
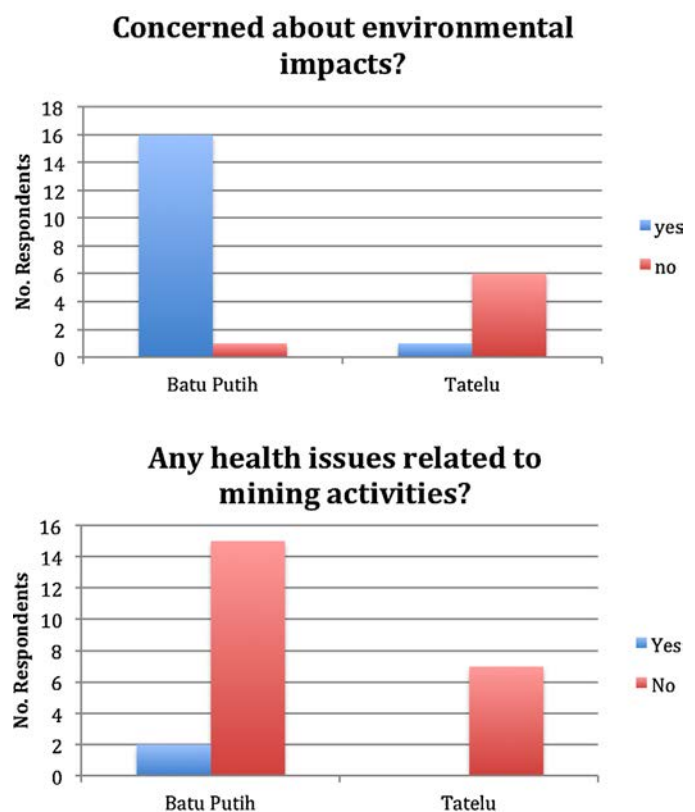

Fig. 7. Perceived impacts of mining on health and the environment at Tatelu (ASM) and Batu Putih Atas (large-scale mine).

accidents. The town health centre has not been involved with health interventions at the ASM sites and the many young men who work them. The doctor on-site was new to the town and was reported to be ignorant of the potential or actual health problems affecting the miners. A lack of adequate records impeded our ability to infer what, if any, health changes or issues have resulted from the processing and extraction of gold.

People in Batu Putih Atas voiced different opinions, particularly regarding the impact of mining on the environment. Most informants who were not workers at the mine thought that there were many negative impacts on the environment and that local livelihoods were negatively impacted. They believed that mining has degraded water and soil conditions and has decreased marine fish stocks. Other than those who receive direct income-earning benefits from the company, most people perceive that livelihoods have been negatively affected by the mining activities.

5. Discussion

The results show a tangible transformation of capital at the ASM site. Extracting natural capital led to financial capital growth. The resulting earnings were then invested in human and physical capital. Local investments have improved roads around the ASM site and in the community. The primary function of the roads is to facilitate the transport of raw and processed ore to different stages along the processing chain. Car and motorbike usage and ownership has climbed in tandem with the development of these roads. In addition the roads are stimulating market connectivity and are allowing greater flows of goods into and out of the area. The settlements around the ASM site include markets, schools, and social infrastructure that would not have been developed without the income from minerals. This illustrates the capital asset transformation required for 'weak sustainability' the only sensible way in which to conceive sustainability relating to the use of non-renewable natural resources for development (Brundtland, 1987; Gutés, 1996; Solow, 2014).

This developmental benefit has to be offset against the environmental costs from incursions into forested areas and the loss of some agricultural and aquaculture opportunities. Rigorous quantification of this trade-off cannot be fully assessed here without access to the EIA, which at the time of writing was not yet available from the local ministry. Further trade-offs include the potential negative effects of poor management of tailings, which are located close to agricultural and aquaculture activities. However, mercury usage is now minimal, as the cyanide processing that has replaced it poses a much lower threat to people and their environment (Sulaiman, 2007; Spiegel and Veiga, 2010). Within the large-scale mining part of this landscape, roads have not provided additional development benefits for local people.

The majority of capital transformation from the large scale mine takes place outside the local community as the gold is exported without passing through any local value chain. The profits go to shareholders and managers none of whom are local. Though some locals gain financial capital, as wages and CSR donations, there is not a critical mass of capital amassed locally to fund investments in education and infrastructure for transformative community benefits. The benefits are only incremental and are not equitably shared throughout the community. Roads to the port city of Bitung were constructed by government, and served the needs of the fishing communities prior to the development of the mine. They are not stimulating expanding market activities, as many people are still engaged in subsistence agriculture and aquaculture.

The Indonesian Mining and Sustainable Development Framework (2013) draws attention to some potential economic threats, which we discuss here in a local context. One, at the ASM site, is the high dependence on a single primary commodity. The profitability of mining can encourage flight from other, sometimes more traditional, occupations to the detriment of more sustainable livelihoods. Another purported threat is that the rate of conversion from natural capital to other capitals can be low and inefficient and that dangerous working conditions, pollution, hazardous materials, and discrimination against women and children, can compromise the wellbeing of the population (Intergovernmental Forum on Mining, 2013). However, the profits brought by the mine are spurring investment in education, and people are investing in community funds, which are directed into other forms of capital accumulation. These community funds mean that capital accumulates under the management of locals who will be accountable for long-term benefits. The instrumental value of this is a heightened sense of ownership and a say in community development outcomes, which has led to capital sharing and transformation and has created more intra and inter-generational equity at this ASM site. The present population is contributing to a situation whereby the current generation is achieving prosperity without compromising future generations' needs, and possibly, prosperity.

Our local respondents around the large-scale mine did not consider mining to be a major beneficial driver of change. Incomes have not, on average, risen. People seem jealous of those employed in the mines but also respect them as they become more prosperous and successful than their peers. Those with jobs are seen as 'professional' and this brings status. This stems from the impression that the jobs are formal, and come with the attire, the fringe benefits and security of a safe and regulated industrial occupation with regular working hours. The families of those employed by the large-scale mine are benefiting from the direct deposit schemes run by the company, as remuneration is paid electronically to a bank account held in the name of the female head of household. This gives her more discretion on the utilization of family money and is a standard practice for large-scale mining employees. This payment scheme is born of evidence that the utility of income is higher when controlled by the female head of household. Women typically spend preferentially on education and improved family nutrition and are said to make fewer frivolous purchases (World Bank, 2011). Yet, in comparison to the ASM site, where a majority of locals claim ownership of the mines and report positive outcomes, the locals at the large-scale mine site remain, on average, suspicious of the mining company's activities. Environmentally, large-scale mining is still driving large-scale change in the landscape. The scale of land clearing and size of the pits is growing and this has large environmental and regional development implications. As the large-scale mine is now majority-owned by the Indonesian Rajawali Corporation, the profits will stay with that company and its major shareholders. The extent to which any profit flows back into local economies is unknown but is certainly very limited. Reinvestment of profits locally to ensure capital transformation within the mined landscape would support local community development but there is little sign of this happening.

Increased local capital retention is only likely to happen if pre-conditions for 'landscape approach' management are met, and this is rarely the case (Sayer et al., 2014). The landscape approach has gained significant traction in the development community as a way to reconcile competing demands on land, and it is common in the natural resource management discourse (DeFries and Rosenzweig, 2010). Landscape approaches are initiatives used to reconcile competing land uses and to achieve both conservation and production outcomes (Milder et al., 2012). The utility of landscape approaches is that they provide a mechanism around which civil society can mobilize to achieve better land use outcomes. Landscape approaches help make sense of the complexity of the landscape and facilitate the investigation of impacts of different

courses of action. For the North Sulawesi landscape and for Eastern Indonesia, a landscape approach could help in the exploration of alternative development scenarios for future mining landscapes as Indonesians navigate the threats and opportunities of incoming investment. As seen in our study, outcomes within a complex landscape are determined by the power differentials amongst stakeholders and the existence, or otherwise, of functional institutions to take decisions and enforce agreements. A first step towards meeting the pre-conditions for landscape approaches means the 'elite with expertise', the higher and more centralized levels of government, which determine the legal and governance conditions under which large-scale mining companies must operate, should take into account the physical and social context in which the mines are embedded. In addition, large-scale mining companies should incorporate the same principles in their CSR standards.

Social capital differs between the sites. There are strong social networks at the ASM sites, which is partly evident by the respect for and knowledge of governance arrangements. Locals attribute their community strength to the success of recent historical events and inspired leadership. During the period of social conflict, in which locals were left to their own devices to confront violence brought by unregulated migration of opportunistic miners, they constructed a governance regime that has not only made them more resilient, but has also brought added benefits and capacity to them. The difficult times they endured led to a strengthening of social capital (Taleb, 2012). The formalization process has increased their political purchasing power with the district level government, and increased land security. However, though the power structure is strong and locals support the control and management of mining operations, payments for security do not have any legal basis. The payments to higher authorities for services are not legally recognized or transparent to outsiders. The head of village maintains verbal agreements with the district offices to use whatever means he deems necessary to keep the mining operations free of conflict and ensure that environmental safeguards are observed. This legal no-man's-land can be thought of as an adaptive response in governing an industry that is still in the transition stages of formalization and recognition by central and regional governments. Formalization, whereby the government extends legal rights to people working in a previously unregulated economic activity, would give more legal authority and recognition to the community governance arrangements, but may prove problematic if it threatens the power structure within community.

The formalization processes need to consider local context such that the benefits brought by strong governance locally are not put at risk by de-legitimizing that local governance. Potential negative outcomes include improper use of power in the formalization process leading to increased income inequality and nepotism, and marginalization of some groups. The fast-changing legal space regarding community mining formalization requires increased scrutiny to determine whether empowerment and beneficial environmental, medical and social outcomes will eventuate. Our data show that formalization will not solve all of these problems. Other studies claim that among already-formalized ASM in mineral-rich countries, strengthening existing regulations is necessary to properly leverage improved livelihoods, and that this is in line with the case study presented (Weng et al., 2015). We also posit possible linkages between the large-scale mining and the ASM sector could benefit this process.

At the large-scale mine site, local power structures contribute less to the distribution of benefits. This is managed by the internal CSR practices of the mining company. The company makes ad hoc payments to leaders of the villagers, to the people on whose land the mine lies, and to other elites in the landscape, including religious leaders. At stake here is a culture of welfare dependency and a set of unsustainable relationships that prevents the large-scale mine's integration into the local economy. It was evident that people hired by the large-scale mine to lead the community relations campaigns within the 13 CSR villages were kept ignorant of many of the basic facts about the mining operation. This betrays FPIC principles, and effectively keeps the communities isolated from possible engagement with large-scale mining-led changes in the landscape.

There are few comparisons of ASM and large-scale mining coexisting in the same landscape, but one study from Ghana shows that large-scale mining, if effectively engaged with ASM, "can yield mutual dividends" (Aubynn, 2009). That study concludes that this must be done in a holistic, multi-stakeholder context whereby governments, civil society, the ASM representatives, and the mining companies engage in a process that enables ASM to become safer, regulated, environmentally sustainable, and equitable. Money that is spent on the social license, mainly in the form of ad hoc payments and some CSR programmes, could be better spent collaborating with local resource stewards to strengthen community mining. We think this is a policy-approach suitable in places where there is potential for ASM and large-scale mining to co-exist in Eastern Indonesia. The landscape approach identifies principles for this best practice, and will contextualize policy making to locally beneficial ends (Sayer et al., 2013).

6. Conclusion

Both small and large scale mining present opportunities for, and threats to, sustainable development in Eastern Indonesia. More evidence is needed on the impacts of both forms of mining, but we found that, at our study sites in North Sulawesi, the socio-economic benefits of ASM outweigh negative impacts, and that the sector provides more benefits to locals than large-scale mining when assets and asset transformation is evaluated at the community level. Our results, therefore, suggest that decision makers should confront the challenges inherent in complex landscapes with competing land uses, in locally contextual ways. In Eastern Indonesia, this means supporting the capacity of local institutions to aid in the process of formalizing community mining. The federal government could stipulate that large-scale mining companies show that they are engaging in dialogue with local natural asset stewards, and investing in their capacity to better address health and environment issues. Changing legal frameworks and weak local governing capacities lead to the ASM sector remaining marginalized, fraught with poor practice and poorly regulated. The formalization process, together with a landscapes approach, offers some potential solutions. To understand governance and rights regimes in Indonesia's informal mining context requires recognition of rural development dynamics through conceptual lenses that are considerably more multi-dimensional than those that emphasize illegality at local scales. Spiegel (2012a,b) argues for a more disaggregated and multi-dimensional notion of the "mining sector" in order to meet the needs of the diverse participants who depend on small-scale mining for income. Our results support this and a landscape approach incorporating social, political, economic and environmental issues in a decentralized, but geographically focused management arrangement, which should help to address the sense of illegality that runs through the ASM sector.

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Chapter 3: Estate crops more attractive than community forests in West Kalimantan

Estate Crops More Attractive than Community Forests in West Kalimantan, Indonesia

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Abstract: Smallholder farmers and indigenous communities must cope with the opportunities and threats presented by rapidly spreading estate crops in the frontier of the agricultural market economy. Smallholder communities are subject to considerable speculation by outsiders, yet large-scale agriculture presents tradeoffs that they must navigate. We initiated a study in Sintang, West Kalimantan in 2012 and have returned annually for the last four years, building the baselines for a longer-term landscape approach to reconciling conservation and development tradeoffs in situ. Here, the stakeholders are heterogeneous, yet the land cover of the landscape is on a trajectory towards homogenous mono-cropping systems, primarily either palm oil or rubber. In one village on the frontier of the agricultural market economy, natural forests remain managed by the indigenous and local community but economics further intrude on forest use decisions. Conservation values are declining and the future of the forest is uncertain. As such, the community is ultimately attracted to more economically attractive uses of the land for local development oil palm or rubber mono-crop farms. We identify poverty as a threat to community-managed conservation success in the face of economic pressures to convert forest to intensive agriculture. We provide evidence that lucrative alternatives will challenge community-managed forests when prosperity seems achievable. To alleviate this trend, we identify formalized traditional management and landscape governance solutions to nurture a more sustainable landscape transition.

Keywords: conservation development tradeoffs; smallholder agriculture; agricultural market frontiers; community-based forestry; landscape approach

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1. Landscapes in the Heart of Borneo

Communities in the Heart of Borneo (HoB), West Kalimantan, Indonesia are receiving international attention from the work of activist groups and action-research scientists [1]. External discourse often deafens us to the articulated perceptions of local people's lives and landscapes [2,3]. Mostly, the discourse victimizes people and their landscapes, subjecting them to scrutiny over their socioeconomic disadvantages. Science often situates their problems at the frontier of agribusiness economies and Indonesia's problematic, and often complex, governance arrangements [4–7]. A common concern entry-point emerges from the challenges and opportunities of new and rapidly-expanding oil palm plantations [8]. Locally, the millions of people living there ultimately face the consequences of this change [9]. Nationally, Indonesia generally prioritizes economic growth over

achieving conservation goals [10]. Internationally, the environmental community focuses on enhancing and maintaining global public goods [11,12]. Communities in the HoB inhabit some of Indonesia's most dynamic frontier land. They are often Indonesia's poorest people, reside in the world's largest transboundary rainforest and face some of the world's greatest rates of deforestation due to the rapid expansion of oil palm [13–15].

The HoB is a tri-national transboundary initiative led by the World Wide Fund for Nature (WWF). Their coordinated efforts aim to sustainably manage landscapes for increased prosperity and biodiversity in Borneo's geographical center [8]. The HoB initiative aims to coordinate Indonesia, Brunei Darussalam and Malaysia to achieve the long term goal of conserving one of the world's most regarded biodiversity hotspots [16]. The initiative was established in response to high rates of forest conversion and degradation. The extent of Borneo's forests declined by 34% from 1973–2015, primarily due to agricultural expansion and El Niño Southern Oscillation (ENSO)-induced wildfires [17,18]. By 2015, Kalimantan (Indonesian Borneo) contained 5.7 million hectares of industrial plantations [18]. Oil palm drives the majority of agricultural expansion in Kalimantan [19]. In 2010, in West Kalimantan, more than half a million hectares of oil palm were under cultivation, with a planned 5 million more hectares, already under concession [1]. Then, 79% of allocated oil palm leases remained undeveloped [10]. Projections show that full development would convert approximately 90% of remaining available forest lands [20]. Oil palm would occupy 34% of lowlands outside protected areas (ibid). Realistically, the development of the oil palm sector receives greater governmental support than meeting conservation targets, including those underlining the HoB initiative [10]. In 2011, the oil palm industry contributed US $20 billion in foreign exchange earnings to Indonesia [14].

To increase conservation impact, HoB operational management is devolved to the landscape scale—a spatial delineation defined by combination of social-ecological parameters including watersheds and political jurisdictions [8]. This stems from evidence that biodiversity and environmental conservation action also aimed at addressing the aspirations and poverty of locals is best addressed at the landscape scale [21]. However, while conservationists lament the rapidly increasing pressures on tropical landscapes from increasing global agricultural needs, agricultural investment is often the only opportunity available to meet rising development aspirations of rural forest dwellers [9,22,23]. Agricultural innovation at the landscape scale must benefit smallholders for inclusive development, a pre-requisite to achieving long-term conservation goals if they are to remain living there [24,25]. In West Kalimantan, local management of resources includes both indigenous management and community-based management. In these local landscape contexts, customary forests have new found legal support for local decision-making and user rights. Conservation and development organizations will need to come to terms with the choices that these groups make for their own interests. The problem is evident: assumptions and expectations of development and conservation are clearly at odds in this landscape.

We have worked with WWFs regional Sintang and Kapuas Hulu offices in West Kalimantan as an entry point for building landscape approach platform for action-research. Ownership and power are hotly contested issues within this landscape [26] and thus taking a landscape approach provides a framework to make progress toward achieving satisfactory outcomes for the broad range of stakeholders concerned [27]. We hypothesize that conservation efforts will fail if local people remain living in poverty. We ask: *what will happen to forests in the control of local people when development opportunities arise?* We use the case study of Kenyabur Baru village in Sintang Regency, West Kalimantan to demonstrate that community forest management fails when the economic returns of converting forest to oil palm exceed those of intact forest. The following reports on lessons from our observations in the Sintang Regency as part of the HoB initiative.

2. Conceptual Framework

The landscape approach is the latest iteration of attempts to integrate conservation and development in defined geographic spaces [28]. A landscape approach is defined as "*A long-term*

collaborative process bringing together diverse stakeholders aiming to achieve a balance between multiple and sometimes conflicting objectives in a landscape or seascape" [28]. The landscape approach seeks to address global challenges of poverty alleviation, food security, climate change, and biodiversity loss [29]. Though it is a refinement of prior approaches, it is distinct as it explicitly acknowledges that satisfying all stakeholders will often be unachievable. However, its aim is to manage these tradeoffs transparently through governance principles that aspire to reach consensus, whereas other approaches portend spurious 'win–win' outcomes by failing to acknowledge the magnitude of stakeholder diversity and the need for compromise and negotiation [27]. Primarily, landscape approaches are a question of governance. The most recent research identifies how landscape practitioners might measure governance processes, recognizing that process is vital to contextualizing and then achieving desirable and sustainable outcomes [28]. Landscape approaches provide a conceptual framework to make long-term improvements to conservation and production by engaging and empowering local stakeholders [30]. Capacity building, local empowerment, improving governance and providing transparency in resource management negotiations are fundamental components of landscape approaches [31–33].

2.1. Community Management in Indonesia's Landscapes

If we truly want to address issues of climate change, poverty, forest and biodiversity loss effectively, the global community will have to devote far greater efforts than has occurred to date to accessing the views, preferences, and goals of marginalized peoples, understanding local social systems, and incorporating such information into policies, laws, and regulations [2].

The communities in the HoB are diverse. Smallholder oil palm communities in West Kalimantan are similarly heterogeneous. Likewise, indigenous groups, non-indigenous farming groups, and transmigrants live side-by-side. There are no simple typologies of oil palm farmers—yet in the discourse, generalizations abound [1,10,14,23]. There are also wide ranging opinions on the promise of community-based natural resource management to deliver environmental benefits [34]. However, policy fails if it is too top down and if it does not acknowledge and involve the power and interests of local people [35]. These communities make decisions over the use of their lands and their decision-making is in the context of rapidly spreading oil palm, stemming from large and intermediate-sized companies [36]. Large and mid-size companies provide economies of scale for smallholder participation in a cash crop economy, triggering its expansion (ibid).

There is a long convoluted history of land-use decision making in Indonesia [34]. Indigenous groups, currently through the National Alliance of Indigenous Peoples (Aliansi Masyarakat Adat Nusantara, AMAN), recently succeeded in moving policy agendas beyond community forest management. They now call for an end to State control over customary land. AMAN defines community indigenous peoples (*masyarakat adat*) as "communities living on the basis of ancestral origins in an adat region, that have sovereignty over land and natural resource wealth; a sociocultural life regulated by adat law; and an adat council that manages the daily life of its people" [37]. By 2014, AMAN claimed to be representing well over 2,000 indigenous communities [37]. Laws to remove customary forests from state control were codified by the Indonesian Constitutional Court in May 2013. Muddying the waters, a powerful union of peasant groups also claim development-related rights and responsibilities over resources. AMAN and the peasant unions campaigning for agrarian reform have very different understandings about claims to adat lands [37]. AMAN wants to reclaim land for 'indigenous' groups who have, by their definition, historic and collective rights to it. The unions however aim to recover as much land as possible to redistribute for poorer communities—indigenous, otherwise local, and migrant alike. The federal land allocation agency codified the ambiguity over adat claims to land when the Ministry of Environment and Forestry issued Ministerial Regulation No. 9 of 2015, that simplifies the concept of indigenous rights into communal rights [38]. Although securing land for the poor and marginalized is noble, the process encourages more groups to claim adat land and to manage it as they wish, within a very broad range of contexts. The implementation of

customary laws in ambiguous contexts causes concern among those who worry about the future of environmental assets, reviving an old fear of the 'tragedy of the commons' [34].

2.2. Flawed Assumptions

Confounding the issue, it is abundantly clear that hierarchies of power do not share the same realities. According to Astuti and McGregor [39], a federal-level stakeholder management leader stated that 'indigenous people owned the wisdom of treating the forest with care, the wisdom that respects nature and the cultural spiritual values'. Indigenous knowledge and wisdom is revered for living harmoniously with nature. This perception of 'the indigenous' reality is a spurious caricature disconnected to reality; indigenous groups also want to benefit from extractive industries and modernity [40]. The assumption that indigenous people are bound to be 'green' has led to conservation organizations associated with concerns about green grabbing strategically engaging with indigenous activist organizations to pursue land claims [39]. Our data shows that in West Kalimantan, heterogeneous communities possess multiple interests, including benefitting from estate crop development at the expense of forest [39].

So-called 'green grabbing conservation organizations' (green grab being a style of land grab to ostensibly pursue conservation or environmental outcomes as core objectives) have also perpetuated the notion that conservation can succeed in the long run in places where people continue to live in poverty [41–43]. This is contrary to evidence that while a population is living in poverty, they will continue to exert pressure on natural resources with negative conservation outcomes [44–46]. More egregiously, conservation efforts can inhibit development pathways and fail in areas where poverty persists [47–50]. We examine these interactions in our study and hypothesize that conservation efforts will fail if local people remain living in poverty.

3. Methods

In 2012 we began applying landscape approach principles [27] to engage and assess landscape level interventions in the Sintang Regency. WWF was our institutional entry-point for building landscape-level governance coalitions, with whom we had previous collaboration. We assert that building a landscape-level process of determining objectives, measuring progress to meet those objectives, and reflecting on lessons learned must be undertaken with the participation of all stakeholders [28]. The sustainable livelihoods framework's capital assets provide our framework for determining landscape explicit assets [51]. We conducted participatory modeling to begin to allow for scientific rigor in establishing the links between interventions and outcomes [52–54]. The process was driven by a multi-stakeholder forum. The forum comprised of representatives of conservation and development organizations (local non-governmental organizations (NGOs), international research organizations and private industry), staff of landscape level government agencies (sub-district and village level), and local people from communities where our WWF connections allowed access. Gender was accounted for in settings both through mixed gender and isolated gender focus group discussions and interviews. In 2015 we provided training in simple modeling techniques using the software STELLA [53]. At this initial meeting, we decided that long-term perception data in villages would prove useful. We therefore utilize villages as sentinel sites for setting up long term panel data [55]. Our panel data is based on interviews with local key informants over the last three years. We interviewed respondents using an interpretivist approach, using a general inductive method [56]. By doing so, we sought answers to specific questions but exercised considerable flexibility to enable exploration of unanticipated issues that may arise. We also held focus group discussions (FGD) around topics of interest, maintaining the same approach as our semi-structured interviews. The working languages of our group were English and Indonesian. The data used for this paper is based on interviews within one village at one end of a landscape transition, they retained forests over which they exercise their adat rights. This paper is based on recent visits and the fledgling panel data to a series of villages, focusing

on one village, Kenyabur Baru in the Sintang district, where community-based forest management remains part of their social-ecological system.

4. Results

4.1. Sintang Case: Development Opportunities Arise

In Kenyabur Baru and nearby villages, transmigrants, indigenous, and local farmers live side by side. Local farmers identified themselves as locally indigenous, i.e. of the local Dayak clan group, or from other clan groups that were not historically from that land, whereas the term ¨transmigrant¨ refers to the government-led re-location schemes. Spontaneous and government-sponsored transmigration has brought waves of Javanese migrants to the area since the early 1900s. The indigenous Dayak populations currently co-exist with migrants and there is a diverse ethnic mix in the area. Dayaks have adopted Javanese cultural ways whilst migrants adopt those of the local Dayaks. Oil palm and rubber are the dominant agricultural endeavors but livelihood outcomes are not homogenous; each family engages in a unique way. This does not fit into the neat dual business model typology of either 'tethered scheme' (plasma) smallholders or independent smallholders. Plasma smallholders usually receive credit from a plantation for planting and inputs. Independent smallholders are unassisted but are dependent on an estate mill to process their fruit. Locals have land in estates through various terms of engagement, and possess land locally. Local respondents indicate that government rules matter much less than local arrangements in the community and between companies with which they have profit sharing/crop agreements. Local people cut forests for either larger companies or themselves, and their cropping size ranges from two to 50 hectares. Land assets do not reflect ethnicity but instead local power relations, which are ethnically mixed; those possessing the greatest social capital in the area are the most land and resource rich. These richer farmers are early adapters of agricultural innovations and are most connected with the town of Sintang and external markets.

> "I have connections in the city and think that the opportunity to live well out here depends on my willingness to be opportunistic, investing in expansion and experimentation so that risk is counterbalanced by delivering products to market, and my freedom to choose that market." (panel data respondent No. 1)

Until oil palm arrived in the 1990s, most of these villages practiced swidden rice cultivation and had plots of rubber agroforests. Consequently, much of the land now occupied by oil palm plantations in this landscape had previously been managed as rubber agroforests. There was very little old growth forest (Figures 1 and 2). Locals have increasingly abandoned traditional shifting agriculture due to increased land pressure from rising population and establishments of estate crops by larger companies.

> "There is not enough land left for us to do what we use to do, some of that is because of our population expansion, some of that is because companies now own large plantations." (FGD respondent)

If local communities can accumulate more land, they prioritize rubber or mono-cropping of oil palm. More recent migrants from Java are more likely to plant something new, such as oil palm in an otherwise rubber-dominated landscape, as they have connection to companies and have been exposed to contemporary industrial processes and economies. A co-operative based in one village with a Javanese leader will often try to push greater oil palm engagement, but many local people still prefer to farm rubber, a practice with years of accumulated knowledge. More migrants have arrived recently, as the promise of prosperity from cash-crops and growing social-networks provided socioeconomic pulls to the forest frontier.

Figure 1. Mosaic of land uses including oil palm and rubber surrounding Kenyabur Baru.

Figure 2. Children clearing root vegetables from newly cleared peatland drainage ditch. The area is being prepared for a rubber plantation.

4.2. A Forest at Stake

We visited Kenyabur Baru to observe the adat forest (Figure 3). Kenyabur Baru is a frontier village, specifically an agricultural market frontier village [42]. Frontier and disputed areas are where pressures for deforestation and degradation are increasing, and control is often insecure and in conflict. Many of the villages closer to the district capital city Sintang have no more natural forests of significant size left. The regional villages are increasingly tied to the economy of Sintang. Sintang's economic growth is primarily linked to the growth of industrial oil palm plantations; rural communities are increasingly participating in this economy. Roads have been developed by the government to get products to market and to access services. The roads are in poor condition—they are unpaved and only accessible by four-wheel drive vehicles or motorbikes. The community desires better access to markets and services via improved roads and economic networks.

> "The road has existed for a long time, without it we would not be here doing what we do now. But we want more, we want to be able to reach markets, we want paved roads so that we are safe in cases of emergencies and for easier day to day lifestyle." (panel data respondent No. 2)

Figure 3. The village maintains adat-managed forests, which lie adjacent to the end of their road. The beginning of the forest can be seen in the left lower hand of the image.

The adat forest in Kenyabur Baru retains high conservation value. Of high conservation value are *Shorea seminis Slooten* (critically endangered) and the *Shorea stenoptera Burck* (endangered). High social and cultural conservation values exist in the forest as food resources, traditional medicine and home-building materials. The adat forest is an old growth, minimally-used forest. There is evidence of large mammals. We observed sun bear markings on trees and locals report recent and regular but diminishing sightings of pig-tailed macaques (Figure 4). However, elders last observed orangutans in their forests more than a generation ago. There are mature strangling figs, abundant lianas and other secondary regrowth due to previous forest clearance, and diverse and abundant mature dipterocarps. The forest sits on peatlands approximately 1m deep, has a leaf litter depth of 15–25 cm, and has a mature complex structure.

Figure 4. Recent sun bear markings on a tree inside the adat forest.

Focus group discussions informed us that the forest adjacent to the community land remains adat forest due to the cultural values they derive from it. While the focus group discussion was comprised of indigenous and migrants, both recent and old, they affirmed a mutual communal attachment to the forest. This attachment is based in benefits provided to them. Benefits provided include non-timber forest products (NTFPs), ecosystem services, and rarely, timber for cash. The NTFPs do not generate income but are used for ceremonial or medicinal purposes (Figure 5). It is prohibited to cut down trees except during financial emergencies when people can sell felled trees to pay for health or schooling (they cited a case of a health emergency). They acknowledged, without prompting, that the forest also benefits them through other provisional services such as micro-climate benefits and watershed stability.

Figure 5. Adat elder showing ceremonial plants found in the adat forest.

For the time being, local adat culture impels those of Kenyabur Baru to maintain forest even if other land uses seem more lucrative to them. However, economics is further intruding on their decision to manage the forests for adat value. In our focus group discussion, there was consensus that the value of converting adat forests to either palm oil or rubber plantation exceeded the value of forests as they stand. When asked why they had not cleared more, they claimed they were waiting until improved seeds became affordable and accessible. Villagers also claimed it would be too arduous to clear the land but they welcomed help to clear it (they did not identify burning the forest as a potential and easy clearing method). Priorities are not the same now as they were in the past; values have changed with proximity to the agricultural market economy. As roads and associated spillover infrastructure have developed, the village has become more integrated into market economies wherein the benefits of engaging with the market economy are more apparent. According to villagers, children suddenly had opportunities to go to schools, healthcare was better, and information technology put the visions and accessibility of modern amenities within reach.

> "The economic opportunities provided by road access originally stimulated by the oil palm industry has made life better. There are some social costs but we all now have a desire for modern amenities and want to live prosperously." (panel data respondent No. 3)

Villagers acknowledge that accessing these amenities means greater participation in the cash economy and that this is incompatible with more traditional livelihood activities. During a ranking exercise, the community prioritized rubber above oil palm as a preferred land use—it was the highest priority land use option for them. As stated earlier, rubber provides daily income, something more valuable than less frequent value chain payoff commodities such as oil palm. They also identified freedom and independence over their silvicultural practices and choice of buyers and middle-men as major reasons for preferring rubber. However, the villagers also contextualized their preferences for rubber. In the present situation, they lack capital, labor and power to manage oil palm. They foresee that with greater incomes, greater connectivity to market with better roads, and with social capital remaining strong, they will convert existing rubber to oil palm. The heterogeneity of the community and their relative 'development' isolation has not led to simple patterns of adat vs local vs transmigrant values in the landscape. Rather, similarities emerged: they firstly aspire for capital reliability. Secondly, once they have reliable incomes and safety nets, they aspire for capital accumulation. Thirdly, they aspire to capital re-investment for their kin.

However, younger community members have a different vision for their future. They foresee a landscape void of smallholders and villagers. The alluring amenities they can see on the internet do not seem as out of reach as they do to their elders. Elders describe a future wherein their progeny can have better access to education and can live better lives without abandoning social values based in adat culture. Young people increasingly regard urbanization processes as desirable.

> "We would ideally choose office jobs but invest in land. We want some forests to remain, but want to profit from our lands and while living in the city. In 100 years there will be no people living here anymore. They will all be either working on plantations or in jobs in the city." (panel data respondent No. 4)

5. Conclusions

> *Local people almost always express a strong desire for development and lament their few opportunities . . . . [1]*

While locally managing the forest in Kenyabur Baru has succeeded in maintaining biodiversity and conservation values, maintaining adat management now appears less attractive to the local community than conversion to estate crops—rubber or oil palm. Many other poor rural communities within the HoB find that managing forests is less profitable than intensive agriculture, and the communities desire prosperity and development [1]. This case illustrates how poverty is a threat

to community-managed conservation success when profitable opportunities to convert forest lands present themselves. While communities aspire to conserve environmental and cultural values, this desire is outweighed by economic factors. The communities' willingness to court more economically attractive uses for the adat land for either oil palm or rubber illustrates how community-based resource management can fail. This is in line with the arguments that biodiversity provides few instrumental values for poor people [57]. As the village furthest from the city with poor road access, those of Kenyabur Baru do indeed lament their few opportunities to develop and they are not going to keep the forest if they can derive benefits from other land uses. Currently there are no other mechanisms offering an equivalent pathway to livelihood improvements.

In the HoB, as agricultural markets approach frontier landscapes, forest dwellers and smallholder communities have transitioned from shifting cultivation and timber production to more sedentary extraction and intensified agriculture. Here, the realities of new economic frontiers force community forestry management to adapt to increasing pressures or they will not succeed. Conservation organizations need to recognize the extent of these tradeoffs and the mode by which local people determine land use if they wish to engage in community driven conservation. Similarly, if community advocacy groups in Indonesia fail to acknowledge local heterogeneity, the desire for development and agency with which local communities determine land use, collaboration or collusion between them will be weak, and outcomes will be unsatisfactory. Past successes of adat management in maintaining the biodiversity in forests are unlikely to be replicable in the face of lucrative alternatives. Adat management cannot be kept separate from modern incentive systems. If elders and community members can obtain benefits from adat management in the face of economic pressures, there could be room for innovation in the form of adat formalization.

An example of successful adat formalization where conservation values were retained is in Danau Empangau, Kapuas Hulu, West Kalimantan [58]. By garnering support from district heads, the community succeeded in checking the power of the industrial actors, reconciling power asymmetries in the landscape. Adat management of high conservation value resources succeeded by coexisting with industrial corporate estate cropping in a spatially optimal way. Other examples exist where the evolution of adat power is decentralized and empowered at a community level and can coexist with formal resource management systems within formal structures of land use governance [59–61]. We assert that governance processes in the form of a landscape approach must be applied to enable this process because it provides a framework and guidance on good practice for landscape processes. Multi-criteria assessments can provide tools for achieving spatially optimal solutions that empower adat management through a landscape approach process [62,63]. Landscape scale governance learning processes could adhere to new measurement principles that ensure societal beneficial landscape outcomes [28].

Poverty and deforestation historically have shared a win–lose relationship, meaning that deforestation is the price of development [46]. The win–lose trajectory has historically been associated with rural development: the conversion of forest to intensive agriculture. In that scenario forests shrink but employment and incomes increase [64]. To reach landscape transition, forest cover must rebound without having lost its ecological memory. This would best approximate a win–win outcome in the long run. Forest conversion resulting in unprofitable agriculture, only providing subsistence or ephemeral income to a poor population that might be even worse off if they were cut off from the market economy, would be the worst, lose–lose case for forests and people.

Landscape management coalitions should direct their effort on improving livelihoods, moving through a forest transition, and maintaining conservation values within a mosaic of different lands uses. Multi-stakeholder forums as part of a management coalition in a landscape approach must engage in good process management to reconcile the local socioeconomic pressures with external drivers of change. Good process management includes negotiation and communication of clear goals, a clear and agreed theory of change, a rigorous and equitable process for continuing stakeholder engagement, connection to policy processes and key actors, effectiveness of governance, and transparency [28].

These should be measured for continual landscape learning, for better evidence-based decision-making. Adat management can coexist within more formal land tenure arrangements, but must benefit from a legal recognition of its role in current formal governance structures. It is clear that organizations must recognise that under some conditions the benefits of deforestation and infrastructure development may outweigh the costs [65]. The governance of local forest resources for long-term gain is only possible if local stakeholders are committed to conservation goals and these goals are supported by durable policy arrangements. If local community and indigenous groups are stakeholders with longer-term commitments for stewardship of resources than politicians making unpredictable volatile policy environments, then they need to be a major driver of policy durability. In Indonesia this is problematic because of complexities and contestations over local lands. AMAN groups have championed the rights of indigenous communal land ownership, yet a competing 'community rights' organization has also championed rights of local communities. A landscape approach wherein a management coalition coordinates visions between actors and agents in the landscape will provide a backbone for durable policymaking.

Presently, there are insufficient institutions in place to guarantee that the forests are managed sustainably. Governance must include coordinated visions and address development needs but forested lands will suffer losses in the face of more profitable endeavors if they are wholly managed by communities in an agricultural market frontier. Ideological arguments that have dominated the discourse and have polarized the conservation and community rights advocates must be met with evidence. Our evidence shows that conservation will not succeed in a community that wants the benefits of more financial prosperity when development opportunities arise.

Author Contributions: James D. Langston conceived and designed the study; James D. Langston and Yazid Sururi performed the field study; Muhammad Munawir helped facilitate field study and contributed to the biophysical and social data; James D. Langston, Rebecca A. Riggs and Yazid Sururi analyzed the data; Terry Sunderland provided insightful edits and ideas to enrich the context, results, and discussion. James D. Langston and Rebecca A. Riggs drafted the original paper and Yazid Sururi, Muhammad Munawir, Terry Sunderland contributed edits and comments to subsequent drafts.

Conflicts of Interest: The authors declare no conflict of interest.

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Chapter 4: Governance challenges in an eastern Indonesian landscape

Article

Governance Challenges in an Eastern Indonesian Forest Landscape

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Abstract: Integrated approaches to natural resource management are often undermined by fundamental governance weaknesses. We studied governance of a forest landscape in East Lombok, Indonesia. Forest Management Units (Kesatuan Pengelolaan Hutan or KPH) are an institutional mechanism used in Indonesia for coordinating the management of competing sectors in forest landscapes, balancing the interests of government, business, and civil society. Previous reviews of KPHs indicate they are not delivering their potential benefits due to an uncertain legal mandate and inadequate resources. We utilized participatory methods with a broad range of stakeholders in East Lombok to examine how KPHs might improve institutional arrangements to better meet forest landscape goals. We find that KPHs are primarily limited by insufficient integration with other actors in the landscape. Thus, strengthened engagement with other institutions, as well as civil society, is required. Although new governance arrangements that allow for institutional collaboration and community engagement are needed in the long term, there are steps that the East Lombok KPH can take now. Coordinating institutional commitments and engaging civil society to reconcile power asymmetries and build consensus can help promote sustainable outcomes. Our study concludes that improved multi-level, polycentric governance arrangements between government, NGOs, the private sector, and civil society are required to achieve sustainable landscapes in Lombok. The lessons from Lombok can inform forest landscape governance improvements throughout Indonesia and the tropics.

Keywords: integrated natural resource management; polycentric landscape governance; Indonesia; theory of change

1. Introduction

Natural resource governance in Indonesia is complex and operates at multiple scales. Power over land is distributed between State, local governments and civil society in diverse ways. Recent years have seen turbulence in Indonesia's decentralization, recentralization, and bureaucratic processes [1]. Decentralization transferred power down the hierarchy, strengthening local claims over forest resources

and giving rise to tenure conflict [2]. Discrepancies between de facto and de jure rights have proliferated in recent years as unclear institutional arrangements led to competition between overlapping claims on forest lands [3]. As a response to these competing and overlapping claims on forest lands, the Indonesian Government established Forestry Management Units (KPH, Kesatuan Pengelolaan Hutan) to integrate natural resource management in forest landscapes [4,5].

Initially introduced in the 1999 Forestry Law, KPHs are mandated to implement sustainable forest management at watershed scale and to be responsive to local economic, social, and conservation goals [4]. They are expected to develop relationships with organizations, government institutions and forest license holders based on coordination, integration, and synchronization. As such, KPHs are mandated to deliver good forest governance, balancing "roles and responsibilities of the government, business community, and civil society, supported by accountable policies and trustworthy law enforcement institutions" [4].

Eight years after their establishment, Forest Management Units have not yet achieved their desired influence over forest management in Indonesia. While still in their development stage, KPHs are struggling with a "complex and rapidly evolving policy and institutional framework", creating uncertainty in their role in forest landscapes [6]. Studies examining the effectiveness of KPHs find there is a lack of awareness and participation among stakeholders, which inhibits the implementation of KPH activities [7,8]. Inadequate implementation, in turn, negatively influences KPH legitimacy as an authority and discourages the adoption of KPH policies by other actors in the landscape [7,9]. Sahide et al. [1] find that in some cases, the introduction of KPHs has exacerbated existing power struggles between provincial and district governments over forest jurisdiction and budgets. Analyzing the policy implementation of KPH development in Riau Province, Suwarno et al. [10] argues that the effective implementation of KPHs will require behavioral change in Indonesian forest management culture.

These studies offer important insights for building the institutional infrastructure for KPHs. However, they offer little insight for improving the incentives and institutional relationships for effective implementation of KPH activities. If KPHs are to adequately fulfil their mandate, their priority must be to overcome barriers to their influence over forest landscapes to gain recognition among institutions and civil society as a legitimate steward of forest resources. If effectively implemented, KPHs may not only be proponents of good forest governance, but could also be an instrument for coordinating landscape governance. Two-thirds of Indonesia's terrestrial landmass is classified as forest estate and it is subject to the second highest deforestation rate globally [11,12]. Most of Indonesia's landscapes are forest landscapes. Therefore forest institutions have a major role to play in broader landscape governance. As stewards of forest resources, KPHs are intended to manage forests for economic value, harmonize spatial planning arrangements and respond to threats and opportunities affecting forest resources. If they are going to adequately fulfil these roles and responsibilities, KPHs must operate across State forest and other tenure boundaries to effectively diagnose and balance the needs of different actors and networks that shape forest landscapes. As bridging organizations [13,14] they can facilitate better coordination and collaboration between different actors whilst developing a more nuanced understanding of demands on forest resources. Consequently, the KPH may drive progress towards effective governance of forest landscapes in Indonesia, meeting social, economic, and environmental goals of integrated natural resource management.

In this paper, we explore and suggest pathways for the KPH to achieve effective landscape governance to meet its mandate of sustainable forest management and we address challenges for achieving this outcome. Using the case study of East Rinjani KPH on the island of Lombok, Indonesia, we discuss the potential for Indonesian Forest Management Units to coordinate landscape governance. We use the term landscape governance to describe the multi-stakeholder process of negotiation and decision making affecting a landscape, including both government and non-government actors intervening across multiple scales [15]. Using this case study, we aim to demonstrate how strengthening governance is crucial to effectively implementing holistic forest landscape management and how Indonesian KPHs can make progress to address challenges inhibiting their mandate [16]. We unravel

the local complexities and provide the depth of understanding of these complexities that is needed to improve local resource management and governance arrangements and capabilities. We demonstrate how KPHs can strengthen their role as bridging organizations in Indonesia to facilitate effective landscape governance and provide incentives to help ensure that civil society and institutions govern resources sustainably and inclusively.

2. Background

2.1. Governance Issues in Indonesia

Forest landscapes in Indonesia are characterized by ambiguity, competition and conflict between de facto and de jure claims on resources. At least nine different ministries and institutions have a role in forest management [17]. Community ownership and diverse tenure arrangements are in the process of being recognized and formalized [18]. Multiple de facto arrangements have always existed in forest areas in Indonesia [19]. Recent legislation committed the Government to allocate over 12.7 million hectares of State forest to communities in coming years [20]. Yet coordinating different visions, missions, and responsibilities in Indonesia is challenging and costly. Conservation NGOs, Indigenous groups, private industries, communities, and government institutions both impact and are influenced by forest management decisions. They also play an important role in forest landscape governance. When incentives for collaboration are absent, each group tends to prioritize its own agenda, framing issues from their own perspective, leading to zero-sum outcomes [1,21]. Opportunities for synergies are replaced by 'egosektoral' agendas. For example, restoration of degraded land may often be seen as a technical problem to be solved by a narrow sectoral approach and this may exclude the interests of legitimate stakeholders such as local communities [22]. The result is fragmented governance; institutions working side by side but with minimal cross-scale and cross-sectoral communication [23]. REDD+ (Reduced Emission from Deforestation and Degradation Plus) activities in Indonesia have largely failed because of lack of coordination among sectors and across governance scales [24–26].

2.2. Pathways to Strengthening Forest Landscape Governance

The introduction of Forest Management Units in Indonesia provides a conceptual framework for effective governance of forest landscapes. The program gained traction in 2010 with support from the German Development Cooperation (GIZ) and over 400 KPHs were established across Indonesia's forest estate. KPH can consist of protection units (KPHL), production units (KPHP), or conservation units (KPHK). Among other requirements, KPHs are responsible for facilitating collaboration and synergies between Central, Provincial and Regency/Municipal Governments [27]. Currently KPHs prioritize forest management interventions that include developing inventories and planning for conservation and restoration. They also have the responsibility to manage conflict, socialize national forest policies and promote partnerships between different actors in forest landscapes [6].

KPHs are strategically designed to integrate existing governance frameworks and develop long-term management plans based on local social, cultural, economic, and environmental conditions [4]. They are appropriately positioned to navigate change towards more effective governance. In Indonesia, a shift to effective multi-level or polycentric landscape governance arrangements might help set a course towards sustainable social-ecological systems. Effective multi-level and polycentric governance means matching institutions to social-ecological processes [28]. In a practical sense, it implies collaboration and communication between different institutions at different scales, such that rules and responsibilities concerning resources are appropriately adapted to local conditions [29]. Enhancing governance will require (1) building knowledge of ecosystem dynamics; (2) allowing constant learning to underpin adaptive management; (3) supporting flexible institutions and polycentrism; and (4) developing capacity for dealing with the unpredictable [13]. As a bridging organization, KPHs can support management institutions to work with one another so that they can build consensus on how their landscapes might deliver the optimal range of societal benefits [30]. They can utilize participatory tools such as developing a theory of change to

help clarify the way to attain better institutional collaboration [31,32]. A by-product of such arrangements can enable weak organizations to gain capacity through institutional co-dependence and learning.

3. Materials and Methods

3.1. Description of Study Area: Lombok

From ridge to reef, the island of Lombok harbors significant biodiversity, along with some of the poorest human communities in Indonesia. Nusa Tenggara Barat, the province comprising Lombok and Sumbawa, ranks 31 out of the 35 Indonesian provinces in the Human Development Index (HDI) [33]. Since HDI is a measurement of life expectancy, education, and income, a low index indicates that the province is underdeveloped. Low socio-economic status is compounded by the effects of harsh climatic and environmental conditions. The people of Lombok are widely recognized by aid agencies for their vulnerability to droughts, floods, and rising temperatures due to climate change. Water resources are already limited; the current water use index for NTB (the ratio between demand and supply) is considered critically high [34]. As farmers look for alternative water sources, they risk placing unsustainable pressure on Lombok's spring water and groundwater—the island's current domestic water supply [35].

Although most of the forest on Lombok remains legally protected, satellite imagery shows deforestation and degradation spreading up Rinjani's slopes from the more accessible lowlands [36]. Since 1990, 28.6% of Lombok's forests have been converted to non-forest land uses [36]. Small-scale agricultural expansion is the main driver of forest loss and land-use change [36,37]. Communities on Lombok rely on forests for ecosystem services including water, timber, fuelwood, and non-timber forest products. Ecosystem regulating services include flood protection, erosion control, and pollination of major crops. Communities also assign customary value to the forests for ceremonial purposes and receive income from tourism [38]. State forests occupy 35% of Lombok's most highly valued and limited resource: land.

3.2. East Lombok

Many of the aforementioned issues are most acute in the regency of East Lombok. High seasonality of rainfall, rising temperatures and water resource scarcity combined with rising population density, lack of economic opportunities and poverty is driving forest conversion and degradation [36,39]. Harsh social and environmental conditions create acute competition for resources and seem irreconcilable with long-term conservation. The system is locked into a feedback loop where poverty and environmental degradation reinforce each other.

East Lombok regency has a population of 1.2 million and spans 160,600 ha, of which 40% is legally designated as forest [40] (Figure 1). The East Rinjani KPH was established in 2009 under the East Lombok Department of Forestry and Plantations. The forest managed by East Rinjani KPH consists of community forest, one timber concession and Kemitraan areas (Table 1). Kemitraan is the Indonesian term for a 'partnership' model—in this case the KPH is working with the local community to plant trees and crops inside the forest boundary for environmental services and to generate local incomes. As the forest in East Lombok ranges from 1600 m to sea level, it encompasses multiple forest types, including moist deciduous, dry deciduous monsoon forest, and mangrove forest. The mangrove forests have largely disappeared from the coast of East Lombok and are now restricted to the small islands of Gili Lawang and Gili Sulat. Land use classification maps [36] show forest conversion to agriculture and shrub land is occurring at the edges of the forest and in populated areas at higher elevations. Shrub land in this case refers to mixed land uses or degraded forest, which are non-forest at present but could return to forest in the future [36]. From our field observations shrub land includes both land degraded by fire and cropland.

Table 1. State forest area and function in East Lombok.

Forest Function	Hectares
Conservation (Rinjani National Park)	27,445.00
KPHL Total Forest	37,589
Protected (ha)	
- Kemitraan for non-timber forest products	31,987
- Kemitraan for tourism	320
	50
Limited production (ha)	0
Production (ha)	
- Community forest (*Hutan Kemasyarakatan*, HKm)	5602
- Kemitraan	420
- Timber concession (*Hutan tanaman industry*, HTI)	285
	2000
Total forest Area (ha)	64,508.67
Percentage of Lombok total forest	39.5%

Sourced from [40,41] and East Rinjani KPH.

The forested slopes of Mt. Rinjani constitute the primary water source for Lombok island [37]. Local communities recognize the relationship between forest cover and water availability; drying springs and unstable river flows are often attributed to deforestation and degradation [42]. Sacred groves exist to protect certain trees for their perceived ability to protect water sources. Sacred groves include exotic species such as mahoni (*Sweitenia macrophylla*) and indigenous species such as jelateng (*Ficus* spp.) [43]. Forests and water are linked on many levels including the hydrological continuum and in the socio-cultural beliefs of the community. East Rinjani KPH is only officially responsible for State forest land in East Lombok Regency. However, its potential to facilitate landscape governance means it is also the de facto steward of water resources.

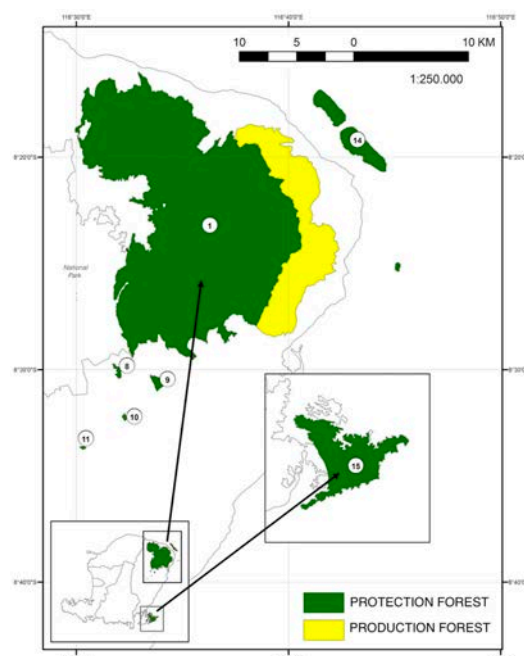**Figure 1.** East Rinjani Forest Management Units (Kesatuan Pengelolaan Hutan or KPH). It is centered on the large forest block at Mt. Rinjani (1). But there are outlying fragments at Gong (8) Petandakan (9) Kedatu (10) and Rebanbela (11) and officially includes the islands of Gili Lawang, Gili Sulat, and Gili Petagan (14), and a large outlier on the south-east coast, Sekaroh (15). Adapted from [44].

3.3. Methods

The site of East Lombok was selected due to our team's longstanding engagement in the area and the specific natural resource management challenges of the landscape. Since 2012 we have visited Lombok annually to work with local development partners. Our fieldwork in August 2016 focused on how landscape governance impacts the Forest Management Unit's integrated natural resource management program. Our approach used interdisciplinary collaborative problem-framing [45] and various visualization and participatory rural appraisal techniques [46] with the aim to co-generate knowledge with local stakeholders for better decision-making [47]. Techniques were selected to help define theory of place and theory of change, addressing the relevant who, what, when, and where questions for landscapes and allowing enquiry into issues that deserves prominence [48]. Relevant and specific methods are described in Table 2.

Table 2. Description of methodological approach, tools and contribution to results.

Approach	Method	Outcome
Collaborative problem framing	Preliminary stakeholder consultation: facilitated discussions with University of Mataram, East Rinjani KPH, West Rinjani KPH community forestry leaders, East Lombok Planning Agency, local government institutions and NGOs. Actor network scoping exercise performed	Preliminary diagnosis of forest landscape governance challenges
Participatory Rural Appraisal	SWOT Analysis: Analysis of community perceived strengths, weakness, opportunities, threats of forest-partnership scheme implemented by East Rinjani KPH	Local perspectives on forest management and incentives for engagement
	Historical Timeline: Built in the villages of Sugian and Sembalun with two village Adat (customary) elders	Understand drivers of change, key events
Knowledge cogeneration	Participatory systems modelling: Exploration of scenarios using Vensim software (Ventana Systems Vensim Profession 6.4b)	Facilitate discussion on synergies and trade-offs in forest management
	Actor Network Analysis: Mapping of actors and power relations, processed in Gephi 0.9.1	Understand existing governance arrangements
	Theory of Change: Identification of landscape challenges, goals, key actors and process for change	Identify the potential contribution of East Rinjani KPH to forest landscape governance

Following preliminary investigations and participatory rural appraisal activities described in Table 2, we facilitated a five-day workshop in East Lombok with members of East Rinjani KPH, University of Mataram forestry students and local NGOs. Invited participants were from Nusa Tenggara and aged between 20 and 35 with varying levels of experience in forest management in Indonesia. Our workshop focused on three landscape issues: reforestation, hydrology, and community needs. We used participatory systems modelling to facilitate broader discussions on the management of social-ecological interactions and revealed the challenges of governance and stakeholder behavior. We then facilitated an actor-network mapping exercise [49] to understand existing governance arrangements. Participants were asked to identify actors in the landscape that either affect or are affected by forest management decisions and to assess power and influence between relationships. We used social network analysis (SNA) software (Gephi 0.9.1) to explore the network. SNA software provided us with an explicit understanding of actor centrality, direction of influence, and types of actors involved. Centrality, calculated through an eigenvector value, symbolizes the importance of an actor, measuring its contribution to the network. Actors or 'nodes' with connections to more influential actors are considered to be more influential than those connected with less influential actors [50]. Our actor-network exercise enabled the group to develop a theory of change for the landscape. We identified process and data needs in building this theory of change [51,52]. The theory of change prompted discussion on how to support the staff of East Rinjani KPH to better understand its potential contribution to conservation and development.

4. Results

4.1. Diagnosing Landscape Governance in East Lombok

　　　Lombok's natural resources are governed by both traditional and non-traditional decision-making processes. Community decisions are influenced by customary laws, known as awig-awig [35]. Government institutions at multiple levels have different roles and responsibilities. At each level of government, multiple agencies exist and are subject to overlapping and often incompatible mandates [53]. Wedged between government agencies are community groups, non-government organizations, and researchers. Officers from the Regency planning agency and KPH reported that short-term projects frequently bring together a subset of these groups but fail to establish durable coordination. Previous studies by Butler and Suadnya [39] support this conclusion. The East Rinjani KPH was established in 2012 to implement integrated forest management and strengthen community incentive for forest and watershed protection. Its capacity to fulfil its mandate is limited by the lack of recognition by other actors in the landscape. Institutions and communities adhere to prior de facto arrangements and resist relinquishing control or ownership over forest resources. The KPH attempts to coordinate with spatial planning and agricultural extension programs but lacks a solid platform for engagement. Rare examples of collaboration do exist; the water management authority works with the KPH to collect district hydrological data. However more frequently, coordination is inhibited by a lack of clarity over roles and responsibilities; multiple water use organizations are present but have overlapping mandates [35]. Table 3 outlines key events contributing to governance arrangements today. Communities are highly dependent on land and resources and have experienced multiple interventions by government, private, and civil actors. Changing forest regulations have weakened trust between community members and government, promoting tensions between government agencies. Communities have observed a longstanding relationship between forest cover and water shortages and this has influenced current opinions and practices.

Table 3. Historical Events in East Lombok (based on key informant interviews in Sambelia and Sembalun sub-districts).

Year	Event
1257	Mt. Rinjani volcanic eruption (Samalas volcano), destroying forests in significant parts of Lombok, Bali and western Sumbawa
1815	Mt. Tambora volcanic eruption, taking the lives of over 80,000 people (located on Sumbawa)
1929–1945	Delineation of forest boundaries under Dutch colonial rule
1945	Coffee cultivation in Sembalun began, mainly for local consumption
1960s	Village elder recalls much more tree cover on slopes around Sembalun
1972	Transmigration program brought people to Sambelia for timber exploitation in State forest area
1975	Road network expansion throughout East Lombok
1977	Transmigration program relocated farmers from Central Lombok to Sambelia, providing each household with 2 ha of land
1979	Rinjani Nature Reserve established. Local villagers drained lake near Sembalun for agriculture
1982	Road to Sambelia district built
1985	Garlic cultivation replaced coffee plantations around Mt. Rinjani, President Suharto visited Sembalun to encourage garlic as the icon product of the region
1986	Department of Tourism established
1988	PT Sembalun Kusuma Emas (SKE) establish garlic plantation in Sembalun (active until 1998)
1989	Timber concession in Sambelia
1990	Mt. Rinjani National Park established Interviewees observed natural spring depletion and increase in illegal logging and fires
1992	MoF defined forest boundaries (KPH Interview) Timber concession owners begin forest rehabilitation program in Sambelia to curb deforestation

Table 3. *Cont.*

Year	Event
1995	Farmers diversify into potatoes, onions, carrots, chili, and other vegetables in Sembalun
1997	El Nino drought affecting agricultural yields and environmental degradation provoking fires The Ministry of Agriculture establishes agroforestry program in Sambelia district (within State forest)
1999	Decentralisation—The Regency Forest Department (Dinas Kehutanan Kabupaten) gained jurisdiction over production and protected forests, while conservation forests remained under the authority of the national government Water management institution Balai Wilayah Sungai (BWS) began working on water issues in Sambelia
2000	Community forestry (HKM) established in Sambelia, 520 people and 420 ha
2002	PT Sampoerna Agro established greenhouse system in Sembalun for tomatoes, peppers, lettuce, broccoli, strawberries, and grapes for export.
2006	Landslide caused flash flooding in Sembalun and Sambelia. Large areas containing houses and crops were severely damaged. Floods raised environmental awareness among communities and were attributed to illegal logging
2008	Community forestry (HKM) established in Sapit village, 715 households and 450 ha
2010/2012	Severe floods on Eastern slopes of Mt. Rinjani affecting Sambelia
2012	East Lombok establish KPHL Rinjani Timur under the district forestry department
2013	KPH commences rehabilitation program in protection forest, planting cinnamon, candlenut, timber trees
2014	KPH redefined State forest boundaries, reducing the area where settlement existed (KPH interviewee)
2015	KPH engages local community in forest rehabilitation and commences Kemitraan program

4.2. Actor Network

During the workshop, participants identified multiple actors present in the East Lombok landscape but were unable to clearly define their respective impact. The actor network map (Figure 2) identifies the influential agents in the landscape active at the district level. Participants focused on natural resource management and the KPH; the map does not identify all potential stakeholders. Visible connections between actors are mainly informal and do not necessarily reflect legislation. NGOs are represented in one cluster, despite a high quantity and variety. We calculated the eigenvector centrality value for each actor, indicating influence within the actor network [50]. The three highest eigenvector centrality scores are KPH (0.99), District Governor (Bupati, 1), District Department of Forestry (0.65), and tobacco manufacturing company Pt Sadhana (0.67). Participants stated PT Sadhana had power in the landscape as it provided income to both civil society and government. At the time of fieldwork, the District Governor and the Ministry of Environment and Forestry were perceived to be the most influential actors in the landscape, likely because they control major financial resources. This was expected to change as the KPH moved from the jurisdiction of the District Department of Forestry to the provincial level. The changing regulations in Indonesia means the long-term position of the KPH is still unclear.

The concession company PT Sadhana is depicted as a powerful actor in the landscape due to its connection through joint venture to PT Sampoerna, one of the largest tobacco companies in Indonesia. PT Sampoerna, despite not being explicitly identified in the actor network, has a significant presence in East Lombok due to its involvement in agricultural production and therefore as a major source of income for the Kabupaten. Participants identified at least sixteen NGOs working with communities in East Lombok. We found NGO influence in the landscape is limited to local civil society groups. However, participants recognized their potential for facilitating interactions between government and communities and this need was also noted by Butler et al. [39]. Our discussions indicated that NGOs, despite being depicted as a single group in the actor network, have different agendas and approaches, in some cases deliberately opposing government. The diversity of NGO positions limits their potential for collective influence. Support from the University of Mataram in aiding the KPH to address landscape challenges is encouraging but not sufficient to address the complexity of the issues.
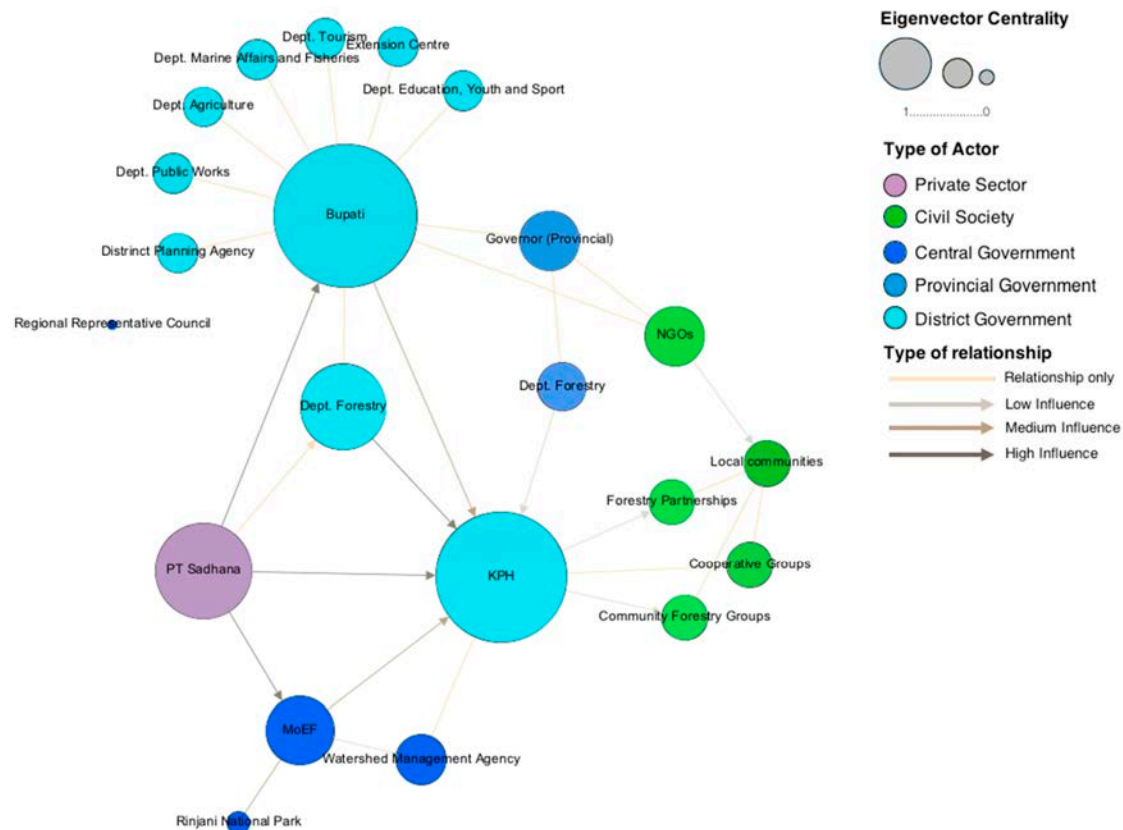
Figure 2. Actor Network. Showing the lack of connectivity between civil society organizations and government actors, apart from KPH, or with the main private sector actor.

4.3. East Rinjani KPH Forest Management

When the East Rinjani KPH became functional, the State forest areas were partly planted with rice paddies, maize, and agroforestry trees. However, unlike other parts of Lombok, most households live outside the forest boundaries. The East Rinjani KPH currently focusses its forest restoration activities in two Kemitraan (partnership) schemes, one within the protection forest and one within the production forest. A comparison of the two schemes is given in Table 4. Members of the Kemitraan are not allowed to harvest timber in the protection forest. A third Kemitraan site also exists for tourism in Sembalun village. The purpose of Kemitraan arrangements is to rehabilitate degraded forest land while providing income for local farmers. According to our interviews, most households in the area own less than one hectare of land and Kemitraan provides access to additional land and offers additional income. During the SWOT analysis, farmers identified the Kemitraan protection forest strengths as increased crop diversity and increased production and income from non-timber forest products. The main opportunities farmers identified were capacity building, expanding networks and partnerships and access to seeds. Farmers felt their opportunities were limited by lack of community capacity, access to market value chains, and the quality and variety of seedlings.

Table 4. East Rinjani Kemitraan profit sharing scheme.

	Protection Forest	Production Forest
Village	Mekar Sari	Sugian
Year commenced	2013	2015
Current size (2016) (ha)	320	285
Number of people involved	Approx. 470	Approx. 200
Land status	Degraded rainforest (approx. 40% planted with agroforestry crops)	Degraded dry deciduous forest with minimal tree cover (approx. 75% rice paddy/maize)
Cropping arrangement	Divided into blocks, each member has one block, no more than 2 ha.	
Main crops planted in rehabilitation program	Avocado Durian Jackfruit Candlenut Cinnamon Tamarind Ginger Mahogany (timber tree) Rajumas (timber tree) Pulai (timber tree)	Sengon (timber tree) Gmelina (timber tree)
Profit sharing arrangement	40% earnings to KPH 60% earnings to members Members pay 1,500,000 annually to village	*39% earnings to KPH 60% earnings to members 1% earnings to village office
Future expansion	<9616.77 ha	<2991 ha

4.4. Theory of Change

Figure 3 depicts the theory of change developed in our workshop. Civil society is positioned as the main agent driving change. The management coalition consists of active organizations, the KPH, and the district government. As one of the few cross-sectoral agencies, the KPH is responsible for coordinating the process; organizing the management coalition and building an alliance between the district government and other institutions. A coordinated management coalition is intended to raise the capacity of civil society members to make informed decisions. This arrangement creates feedback loops and ensures continued stakeholder engagement. Citizen groups have a responsibility to contribute towards spatially explicit inventories of the natural, social, physical, human, and financial assets of the landscape, giving them the power to identify appropriate institutions and build an appropriate platform for negotiations amongst stakeholders. The inventories would be centrally curated by the KPH, who would make inventories transparent and accessible to all stakeholders. Collaboration between the management coalition and civil society leads to interventions that are legitimized by the district government and local regulations. Participants felt it was important to ensure that these interventions were coordinated across multiple scales, including a national policy to harmonize all land allocation maps known as the "one map" initiative and make this the basis for provincial development plans. The KPH would like to see forests restored to benefit local people via profit-sharing schemes. Informants from nearby villages recognized the value of tree cover but at present obtain more benefits when they clear land for crops. Young local NGO members look forward to increased tourism, stronger outside connections and technological modernization of the landscape. Through building a theory of change, differing views converged into an overarching goal: improved landscape and livelihoods, with multiple outcomes and impacts. Priority outcomes were improvements in incomes, agricultural productivity, education, and coordinating institutions. Outcome goals are linked and there are positive feedbacks between them. The theory of change represents a long-term adaptive process. Process and outcome metrics will be necessary to evaluate progress [32].
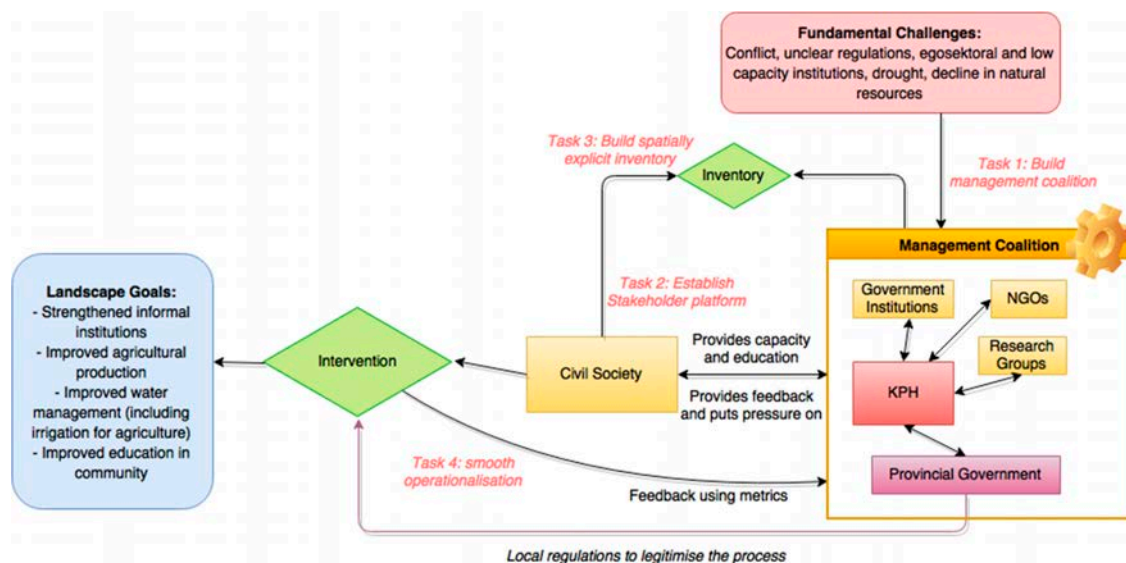
Figure 3. Theory of Change for East Lombok landscape.

5. Discussion

Our results show that unclear regulations and tenure conflicts encourage people of East Lombok to exploit resources opportunistically and this leads to degradation of their environment. Drought, floods, diminishing water supply and forest degradation are key concerns for all actors but institutions and institutional arrangements lack the incentives, power and capacity to deal with these cross-sectoral issues. The actor network analysis and theory of change in this case study support the positioning of the KPH as a bridging organization to foster cross-institutional collaboration and strengthen landscape governance [28]. Yet persistent and fundamental governance challenges of the East Lombok landscape require asking what practical actions can be taken in the short and long-term. If East Rinjani KPH were the responsible institution for coordinating landscape governance, how could it direct change and lead progress towards effective polycentric governance?

Current priorities for the East Rinjani KPH are; (1) building institutional and civil support for forest landscape management; (2) developing incentives for community engagement and; (3) developing locally appropriate solutions that address social-ecological challenges. The theory of change developed at the workshop identifies pathways for the KPH to achieve effective landscape governance, outlining key tasks that would enable the East Rinjani KPH to build capacity for effective polycentric governance while making progress towards these objectives. Understanding landscape dynamics and the complex arrangements that either enhance or inhibit sustainable management are vital to effectively implement key KPH activities, such as forest restoration [15]. By focusing on strengthening cross-institutional communication and information sharing, the East Rinjani KPH can improve the processes that shape forest management decisions [29]. A growing body of literature demonstrates the contribution of polycentric governance to sustainable forest management [29,54,55]. Acknowledging the complexity and the difficulties of transforming governance, the four steps below focus on preparing the system for change, including building support among different actors for integrated landscape management. We deduced the steps from the results of this case and they recapitulate the strategies developed by Olsson et al. [56] for transforming governance in social-ecological systems. The theory of change (Figure 3) describes the explicit change mechanisms linking the tasks below to the landscape challenges and goals identified during the workshop.

5.1. Building a Management Coalition

The first task described in the theory of change is building the management coalition. Currently in East Lombok, multiple actors are working in the landscape with inadequate coordination and collaboration. Climate change research organizations, NGOs, agricultural extension programs, and community development groups work with local communities but operate in silos with different methods, budgets, and targets. The priority for the KPH should therefore be mapping actors within the landscape and using stakeholder analysis or social network analysis procedures [57]. Stakeholder analysis involves identifying key actors in the landscape and assessing their power, influence, and legitimacy [58]. Understanding these characteristics should enable the KPH to establish social networks and gain knowledge of the social-ecological relationships within East Lombok. Multiple methods of stakeholder analysis exist and can be applied in this context.

5.2. Establish a Platform for Stakeholder Dialogue

Once a management coalition is established, the KPH should build a platform for dialogue with civil society to motivate engagement and incentive for landscape management. Frequent dialogue between stakeholders will help build trust, develop norms, and identify shared objectives that can be achieved through improved landscape governance. The quality of stakeholder participation and collective decision-making will depend on the nature of the process [59,60]. Outspoken and engaged members of civil society can mask power differentials and the needs of marginalized groups. As process facilitator, the KPH will be responsible for ensuring different groups are represented and their voices heard. We agree with Reed [59] that long-term success of stakeholder engagement requires the institutionally embedding of participation into governance processes. The methods to achieve effective stakeholder participation in East Lombok will need to take into account local context and stakeholder dynamics, including the diverse range of NGO activities and goals. If the KPH can create a governance culture that embraces feedback between institutions and civil society they will have made immense progress towards the landscape goals depicted in Figure 3.

5.3. Establish a Spatially Explicit Inventory

Effective polycentric governance hinges on how well institutions and responsibilities are matched to the social-ecological components of the landscape [29]. Currently, multiple interventions and studies are being undertaken in East Lombok but there is no mechanism for sharing knowledge. Building a spatially explicitly inventory of all attributes of the landscape, including data on the stocks and dynamics of human, social, natural, financial, and physical assets, can help inform management interventions [32]. Considering the KPH mandate, we argue that it is well-placed to centrally curate this inventory, and facilitate co-learning with the full range of stakeholders. Curating the knowledge inventory should involve co-generating and maintaining knowledge of ecosystem dynamics with the local community and other actors in the landscape. Participatory activities and visualization techniques can elucidate local desires and values using informal inexpensive processes [46]. In addition, previous research and development projects could provide useful contextual data that is otherwise unattainable [36,39,61,62]. If motivated by the KPH, multiple actors can contribute to the knowledge inventory through citizen science [63] and information exchange, including local NGOs, water management groups, government institutions, and farmer cooperatives. The inventory can also contribute to stakeholder discussions and should be used transparently to make trade-offs explicit during decision-making processes.

5.4. Operationalize the Theory of Change

The KPH can act within its mandate to drive a collaborative process of building a theory of change for the East Lombok landscape. The theory of change would provide a comprehensive conceptual framework for how actors in the landscape perceive the key challenges and goals and their shared

vision for making progress towards those goals. The KPH could then 'direct the local context through adaptive management', coordinating and mobilizing actions and creating incentive for continued engagement [56]. Formalizing arrangements may help to overcome institutional barriers and build durability in the process, especially if it is supported by civil society. Process metrics suggested in Sayer et al. [32] could provide a framework for measuring progress towards the improved landscape scenario. Experimentation, learning, and adaptation will be required.

5.5. Current Challenges Inhibiting Progress towards Improved Governance

The potential for the East Rinjani KPH to deliver improved forest landscape governance is limited by Indonesia's lack of a formal legislative framework for coordinating sectoral interventions in landscapes. Planning is dominated by sectoral approaches. The KPH is legally restricted to operating inside State forest boundaries, inhibiting its capacity to take a holistic landscape approach. Current mechanisms for improving landscape governance (such as the KPH) are not sufficiently institutionalized or financially supported. East Rinjani KPH officers were very uncertain about their future. Their budget and program was unclear and apparently subject to politically imposed change. Integration between KPHs and local government, existing forest management instruments, and other sectors has not been realized. As bridging organizations, KPHs should not only be responsible for building local capacity for effective governance but also negotiating change at a higher level [56]. They need to be able to influence decision makers at provincial and central levels, managing communication and information sharing both up and down the hierarchy. In East Lombok, ambiguity over natural resource legislation means the role of the KPH in high level decision making is unclear. Overcoming barriers limiting KPH integration into forest landscape management should be the main priority for KPHs moving forward. By bridging the gap between civil society and decision-makers, East Rinjani KPH can help translate local needs into policy and action and clarify responsibilities in the landscape. The actor network map shows civil society groups are well connected to each other and to the KPH, but rarely to other government sectors. Several clusters in the network are not communicating effectively. Local government involvement (especially at the district level in Indonesia) is crucial for legitimacy and building trust among stakeholders. The KPH staff recognize that to achieve their mandate, they must first build consensus among institutions and civil society on how to achieve landscape goals. Fischer et al. [6] report that the KPH leadership sympathizes with these conclusions Indonesia-wide. While they lack control over institutional structure and budget, their capacity to implement their mandate is largely dependent on the willingness of other actors to engage. If the KPHs could facilitate a process that builds social capital between institutions and civil society they could help overcome constraints in legislation for improved landscape management.

5.6. Poverty as an Inhibitor of Nature Conservation

A second challenge inhibiting improved governance in East Lombok is the lack of incentives for managing natural resources among civil society groups. Poverty is frequently recognized as an inhibitor of forest restoration and conservation [64]. Participants at the workshop assumed that the fundamental landscape challenges and goals would be sufficient to motivate civil engagement and cross-sectoral collaboration. While the social-ecological conditions in East Lombok constitute a common concern, we contest the assumption that civil society will engage in forest landscape management without explicit and strong incentives. Andersson and Ostrom [65], have shown that local actors often bear a substantial part of the costs of environmental conservation while receiving only a small part of the benefits. Our observations in East Lombok were that households prioritize meeting daily food needs over long-term conservation. Changing forest utilization arrangements and access rights have created distrust among the community. Farmers would rather harvest timber illegally now than rely on an agreement that might provide them with income in five years' time. While improved landscape governance arrangements are likely to contribute to forest management, it is less clear how these arrangements will address key concerns of civil society such as education

and water security. Interventions requiring buy-in from local communities should be matched to local needs and motivations [30]. To inspire commitment for improved landscape governance, East Rinjani KPH will need to support interventions that benefit local resource users. Local communities may be unwilling to sacrifice short-term gains for long-term wins, especially if their livelihoods are not secure.

The KPH will have to reflect upon and adapt its long- and short-term management plans so that they adequately address the root problems in the landscape. It will have to learn from and reconsider its interventions so they effectively meet community needs while achieving environmental goals. Interventions that address underlying problems in the East Lombok landscape such as flooding, water scarcity, or agricultural productivity are likely to deliver stronger incentives for participation and ultimately lead to better conservation outcomes.

Progress will require restructuring institutions and responsibilities to improve efficiency and effectiveness. The KPH will need to manage egosektoral agendas and find a common concern entry point [66] to reconcile conflicting objectives. Better knowledge of drivers of change and interlinked agricultural, hydrological, and ecological processes would make assumptions about optimal land use arrangements and stakeholder objectives explicit.

6. Conclusions

Demands on natural resources in Indonesia are growing while governance arrangements to resolve competing claims are weak. Current trends are toward recognizing the importance of functional multi-level and polycentric governance; however, implementing a systems approach to natural resource management will require overcoming significant institutional and practical barriers. Our study concludes that Forest Management Units can fulfill their role as bridging organizations for improving forest landscape governance in Indonesia by strengthening institutional relationships and incentives for stakeholder engagement. We recognize that currently KPHs have a restricted mandate and cannot operate outside State forest boundaries. Incentives for KPHs to include non-State forest land within forest landscape management could improve their capacity to achieve their mandate. In complex forested landscapes, legislation alone is unlikely to solve problems—better management must carry that burden. In East Lombok, we find building social capital for effective polycentric governance appears to offer more hope for progress than broad-based institutional change. Progress can emerge from social networks and interactions between private, public, and civil society groups outside formal government structures [67]. Communication and feedback need to flow vertically and horizontally through hierarchal structures. However, meaningful progress towards integrating conservation and development in East Lombok will also require change at higher political levels. Indonesia suffers from a multitude of natural resource conflicts, many of which cannot be resolved at the local scale. Despite numerous poverty and climate change adaptation projects from international NGOs and governments, East Lombok still lacks a coordinated and contextualized approach to dealing with crosscutting issues [39]. We attribute much of this failure to the challenges of dealing with complex systems. Government agencies and NGOs simply do not have the time, budget, or resources to tackle challenging problems [68]. Meeting East Lombok's landscape goals of strengthened institutions, forest production, water management and community capacity will require legislative and government support. The needs of farmers and communities should be addressed in provincial development plans and accounted for in government expenditure. For Indonesian KPHs and other institutions implementing forest landscape management, relatively simple processes such as formulating stakeholder networks and building a platform for engagement can enable progress towards effective landscape governance. These are short-term actions that should lay down the foundations for long-term landscape transformations. Further research demonstrating the effectiveness of practical ways for dealing with complex systems is required to strengthen evidence-based decision making. Coordinating landscape governance is resource-intensive and requires strong leadership and adaptive management. Currently, KPHs may lack the capabilities to transform governance in forest

landscapes but they can make progress by catalyzing cross-sectoral collaboration and exploiting civil society's commitment to reconciling landscape-level social-ecological conflicts.

Author Contributions: Y.S., H.S.L. and A.K.B. facilitated field workshops; C.M., D.A.S., J.S., R.A.R. and J.D.L. analyzed the data; R.A.R. and J.D.L. wrote the paper. H.S.L., A.K.B., C.M., D.A.S. and J.S. contributed edits and comments to subsequent drafts.

Conflicts of Interest: The authors declare no conflict of interest

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Chapter 5: Conservation and development pressures intensify on one of Indonesia's least developed large islands, Seram

Conservation and development pressures intensify on one of Indonesia's least developed large islands, Seram

Abstract

Seram is Indonesia's 8th largest island. It is central to the historic spice islands, once a hotbed for international trade of profitable tree-products, primarily clove and nutmeg. Recent increased rates of social and ecological change, including costly conflicts, present Seram with new challenges and opportunities for conservation and development. Using place-based transdisciplinary research methods, we diagnose the problems emerging in Seram. Engaging with actors across multiple scales and sectors, we use participatory techniques to understand drivers of change, social-ecological impacts, and institutional arrangements that might achieve improved inclusive and sustainable development outcomes. Traditional and formal governance arrangements require harmonizing to optimize the benefits and costs from large-scale investments arriving in Seram. Organizations wishing to achieve positive impact can more strategically engage with the broad range of actors to harmonize divergent visions for the future and confront the reality of incoming investments and infrastructure.

Key words

Introduction

Island land and seascapes in Indonesia are unique places from which we can learn lessons about development processes. As a nation-state comprised of 17,000 islands, of which 6,000 are inhabited, Indonesia has amongst the world's most biodiverse terrestrial and marine ecosystems. Indonesia is home to the fourth largest human population globally and its people aspire to increased economic wellbeing. More than 700 language groups, more than 73 political parties, and extraordinary attention from 'external' actors makes for high order institutional complexity, contributing to diverse and dynamic governance arrangements (Riggs et al., 2018, Pirard et al., 2017).

Seram is Indonesia's 8th largest island and has rich land and mineral resources, and rich threatened, marine and terrestrial biodiversity (Critical Ecosystem Partnership Fund, 2014). It is the largest island of Maluku province, historically known as the center of the Spice Islands. Vestiges of separatist movements remain in Seram since Indonesia declared independence from the Dutch. Conflict between Muslim and Christian communities at the turn of the millennium left social wounds that are still healing. Being far from the administrative and economic juggernauts in Indonesia's west, communities in Seram have been relatively isolated and left to their own devices (Tjoa et al., 2018). As such, Seram has been disconnected from the costs and benefits of 'business as usual' development processes characteristic of western Indonesia (Margules et al., 2015, Liswanti et al., 2013). However, economic, political, and social changes are presenting Seram with new

opportunities for development, including large infrastructure investments, estate crops, and village centered government programs.

Seram's extraordinary biodiversity, cultural diversity, and relative isolation from the administrative and economic centers in western Indonesia raise questions as to how development will unfold. Will new opportunities in Seram deliver sustainable and inclusive development for the island's inhabitants? Are existing governance arrangements adequate to deliver inclusive benefits, minimizing negative social and environmental impacts and reconciling trade-offs?

Indonesia's development threats and opportunities, alongside its rich but threatened nature, demands governance that can deliver optimal outcomes for people and nature. Interactions between social, economic, and environmental factors underpin governance and occur along continua of temporal and spatial scales (Gunderson, 2001). As peripheral islands in Indonesia gain connectivity and investment, private firms, government agencies, and local communities will need to adapt to achieve well-functioning landscapes. This paper examines rapid and large scale social, economic, and environmental changes in northern and eastern Seram. We highlight the potential for new development opportunities to deliver inclusive benefits and present local perceptions of change. We identify potential winners and losers, and how institutions and organizations can improve their capability to adjust to and manage new development opportunities. Strengthening governance arrangements requires closing gaps between traditional and formal institutions and increasing local involvement in decision making for shared benefits of development. We consider how large-scale investments can be managed in ways that drive sustainability and inclusive prosperity for vibrant remote island economies.

Research Setting

Social-Economic landscape

Approximately 1.1 million people live in the administrative districts that include Seram (Figure 2) and its surrounding islands; forty percent of these people reside in the provincial capital located on neighboring Ambon island (BPS, 2018). The remainder of the population, 656,000 people, live at population density of approximately 30 persons per km2 in administrative centers located on Seram's coastline (Liswanti, 2012). The population density across the island varies from 859 persons per km^2 in Masohi City to 2 persons per km^2 in North Seram. The population of Seram ranks amongst the poorest in Indonesia by aggregate development indicators and the gap is widening; their development lags behind western Indonesia (Figure 1). The population growth rate is officially reported to be 2.8% but is likely higher as population figures from remote rural areas appear to be under-reported and in-migration from other densely settled parts of Indonesia is significant (BPS, 2016). There are at least 38 recognized language groups on Seram. Ethnographical research has described how local beliefs in supernatural agency influences the peoples' behavior (Sasaoka and Laumonier, 2012). A legacy of ethnographic work examining taboos on Seram has drawn scholars to the exotic nature of the island and its inhabitants (Valeri, 2000).

Historical trade interactions have shaped the social landscape in ways that are still visible today. Coastal areas and small islands are more integrated into market based political-economies brought by colonial and regional trading networks (Ellen, 2003). The residents of the inland swamps and mountains of Seram have remained less integrated. They relied on intermediaries to exchange sago products and bush meat for manufactured goods (Stark, 1996). Although recorded history shows that Seram's population is divided, with an interior population of subsistence farmers remaining underdeveloped, and a coastal population that is well-connected and engaged in the trade in spices and other manufactured goods, this is changing rapidly (Ellen, 2000).
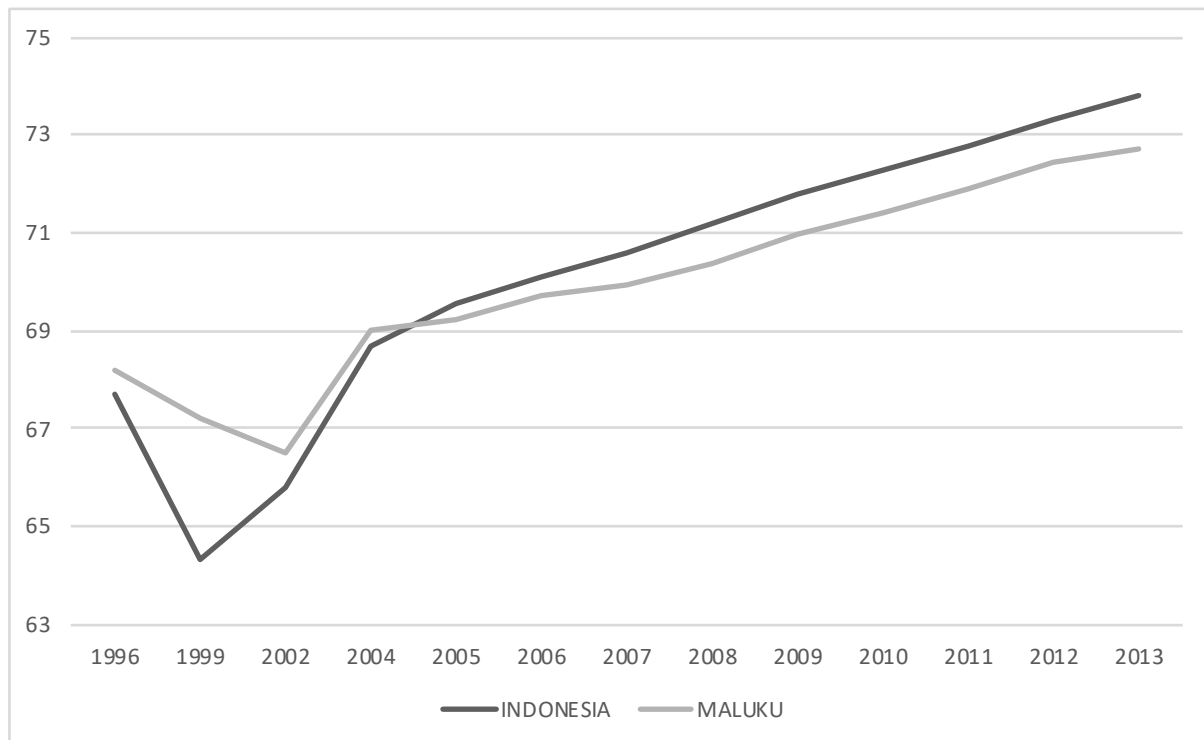

Figure 1. Human Development Index trends for Indonesia as a whole, and Maluku province. Human Development Index is an aggregate development index of GDP per capita, life expectancy, and education. Data retrieved from Indonesia's government statistics bureau (BPS, 2015)

The people of Seram include Muslim and Christian communities. In 1999, violence spread across the Maluku province resulting in thousands of deaths and the displacement of tens of thousands of people (Rao and Vidyattama, 2017). The Malino II Accord, signed in 2002, helped to mediate tensions and stabilize social systems in Seram. However, conflict discouraged investment and inhibited economic development (Rao and Vidyattama, 2017). In rural areas, livelihoods are still reliant upon natural resource extraction from forests and marine environments. In the years following the 2002 peace accords, continuing small conflicts have risen over land, perpetuated by legal ambiguity over land and natural resources, as seen in other parts of Indonesia (Riggs et al., 2016, Liswanti, 2012). Administrative borders are still being finalized at village and district levels. In remote areas, external organizations have engaged with government and local communities to develop and strengthen land use planning (Liswanti et al., 2013).

Biophysical context

Seram has never been connected to either the Sahul or Sunda continental plates. The flora and fauna evolved in relative isolation and levels of endemism are high. The lowland and montane rainforests of Seram are refuges for biodiversity that have been only lightly influenced by patterns of human settlement. The island has a geologically complex, mountainous center – 11% of which is designated as Manusela national park (Pownall et al., 2017). Manusela national park contains one of the bigger intact areas of high biodiversity rainforest in Indonesia and is a refuge for the numerous endemic species that make Seram a priority conservation area within the Wallacea biodiversity hotspot. In the most remote montane forests, local communities have made livelihoods out of selling exotic bird species, at least since the 1970s (Valeri, 2000). The lowland forests have been enriched with spice trees – nutmeg and cloves – which have been the mainstay of the economy of the island for over a thousand years. Mixed tree cropping is still a vital livelihood component in Seram and many of the locally endemic bird species thrive in these agroforest habitats.

Seram is the second largest island in Wallacea, a global biodiversity hotspot (Myers et al., 2000), and distinct biogeographical region located between Asia and Australasia, named after Alfred Russel Wallace (Michaux, 2010). Hotspots are identified on the basis of biodiversity, degree of endemicity, and level of threat (Bibby et al., 1992, Myers et al., 2000). Seram ranks as a high global priority for conservation against these criteria. The Critical Ecosystem Partnership Fund (CEPF) is one of the biggest international funding mechanisms for projects aiming to conserve biodiversity while ensuring sustainable development outcomes for local people. The CEPF completed a conservation priority setting exercise for the Wallacea region in 2014. The report identifies the region's high biodiversity and its threats—more than half of the mammals, 40 percent of the birds and 65 percent of the amphibians found in Wallacea do not occur outside the hotspot, and 560 species are listed as globally threatened (Critical Ecosystem Partnership Fund, 2014). In 2018 the CEPF completed a round of funding worth USD 6.85 million for Wallacea. CEPF granted funding to 80 projects that target Key Biodiversity Areas (KBAs) within the Wallacea hotspot (Figure 2). Seram includes eighteen KBAs, of which thirteen are terrestrial, five are marine. The KBAs cover twenty-five percent of Seram's land mass, including the six nearby islands (Ambon, Haruku, Saparua, Boano, Kelang, and Manipa). When marine KBAs and ridge-to-reef systems are included, high priority conservation areas cover 800,000 ha of the island and its coastal waters.
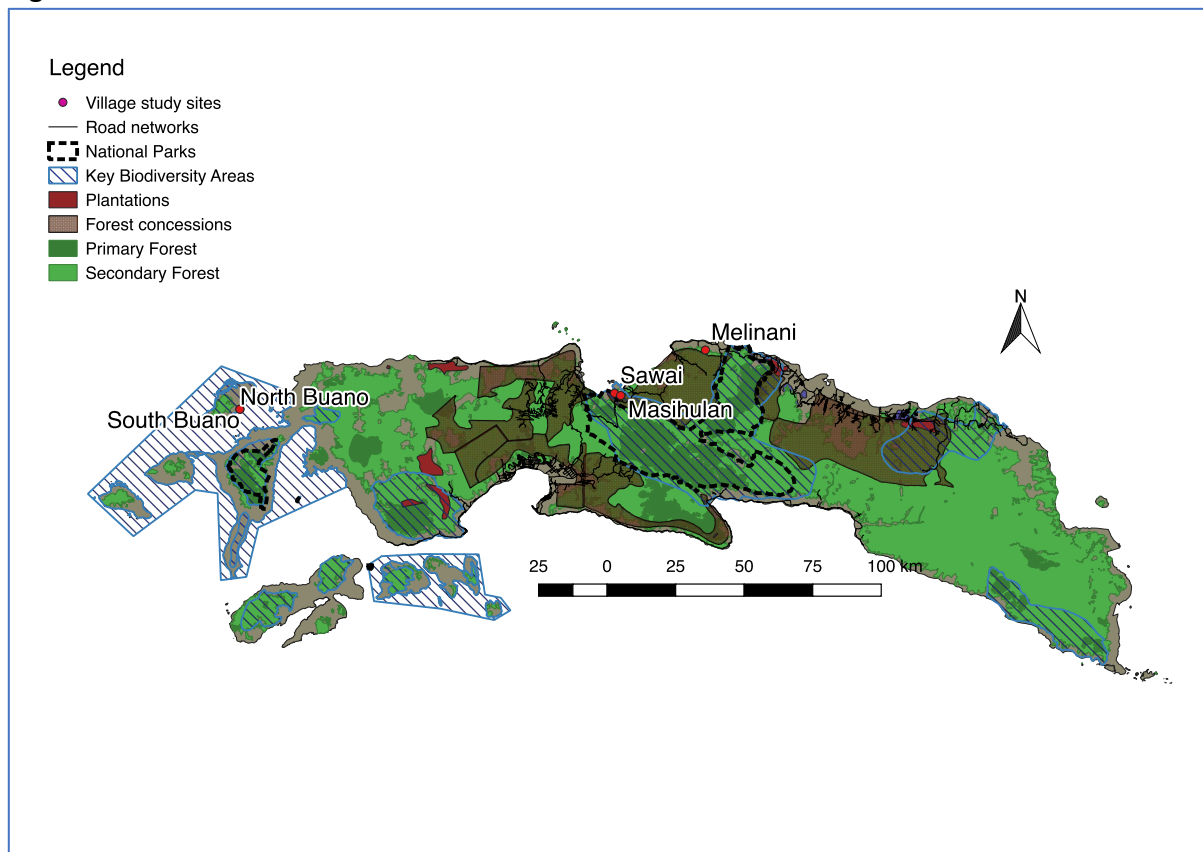
Figure 2.

Figure 2: Map of Seram and surrounding islands showing forest cover, key biodiversity areas and land designated for plantations

Rising conservation and development pressures

In Seram, increasing rural populations and in-migration are contributing to the spread of settlements across lowland forest areas. Large-scale investments are planned or already under-way and are supported by government infrastructure investments. Estate crops are expanding, forest concessions awarded, a major oil and gas extraction project is located in the East of the island, and the road, port and communications infrastructure is being improved. The forests of the national park and other high mountain areas remain well conserved due to historically low populations and difficult accessibility. The mountainous terrain of the island's interior should continue to protect forests from large scale development but the coastal lowlands are under growing pressure from agricultural expansion (Liswanti et al., 2013).

Seram falls east of Wallace's line, a region that contains only 15% of Indonesia's population and contributes 15% of its GDP (Margules et al., 2015). Margules et al. (2015) argue that Eastern Indonesia exhibits a finer scale diversity than western Indonesia – geopolitically and biologically, making for complex spaces that are not as easily controlled by central government authorities (Scott, 1998). In the post-colonial period, poor market integration has isolated Seram and contributed to lingering poverty and a lack of economic development (Apituley, 2012). During the Dutch colonial period, Seram was the best connected part of the Dutch East Indies; the legacy of Dutch separatist movements is still strong. The recent divergent gaps are closing. People practicing customary management of

forests are adjusting to modern market opportunities. There is now less reliance on Sago the main traditional food source (Sasaoka, 2003, Sasaoka et al., 2014). Land-use and tenure systems are changing, with varied positive and negative effects on local social-ecological systems.

Ensuring the sustainability of incoming investments on Seram will require "balancing multiple objectives, the equitable inclusion of all relevant stakeholders, dealing with power and gender asymmetries, adaptive management based on participatory outcome monitoring, and moving beyond existing administrative, jurisdictional, and sectorial silos" (Ros-Tonen et al., 2018). Distance from markets and administrative centers and continuing economic and social recovery from conflict on Seram will continue to pose challenges in dealing with incoming investments that are likely to transform Seram's landscapes. There have already been cases where local leaders broker deals with major industrial investors in ways that are not consistent with provincial or central government plans and in ways that impinge on the traditional rights of people (Ducos, 2014). Institutions on the island lack capacity to direct incoming investments in ways that benefit locals and help ensure long-term, wise stewardship of natural resources (Boedhihartono, 2017, Langston et al., 2015). If governance does not function to deliver inclusive and sustainable development, Seram's development trajectory might resemble a lose-lose scenario; the loss of valuable marine and terrestrial biodiversity and entrenched poverty.

In this paper we examine northern and eastern Seram to consider how local social and environmental systems, including the institutions that govern them, are handling rising conservation and development pressures. We aim to contribute to the understanding of the relationships of social, economic, and environmental outcomes on the island.

Methods

In 2017, our non-government organization (anonymous for peer review purposes), an association of scientists interested in applying science to achieve productive land and seascapes, embarked upon a program to trial landscape approach principles (Sayer et al., 2013) on Seram. Our objectives were to diagnose the current issues preventing the landscapes from functioning well and determine where coordination and commitment could leverage more sustainable landscape outcomes. We were particularly interested in securing the long-term viability of certain endemic species that have led to parts of the island being designated as a biodiversity hotspot. Our interests were to understand how local social-ecological systems function and to work with local communities and the administration to improve long-term stewardship of natural resources. We sought to learn how institutions manage benefit flows from terrestrial and marine ecosystems, and how these flows will evolve alongside development models that meet the desires of local people. We have been returning to Seram for extended periods since early 2017.

Our embedded science approach uses transdisciplinary problem-framing to determine what the problems are, and sustainability science to cogenerate knowledge for better decision-making to solve emergent problems (Chambers, 2014, Polk, 2014, Lang et al., 2012, Clark, 2007, Langston et al., 2019). Our entry point into the landscape was our status as an NGO, the information gathered contributed to understanding of landscape issues, described here,

as well as building partnerships for implementing sustainable natural resource management. Our stepwise approach is outlined in Table 1, involving diagnosis of the system, analysis of social and environment trade-offs and building consensus on desired futures in the landscape.

We engaged with various actors at the provincial, district and village level to determine key institutions, challenges and potential outcomes needed for sustainable landscapes. We used visualization and participatory rural appraisal techniques to diagnose and 'enter the system' (Boedhihartono, 2012, Sayer and Campbell, 2004). Our engagement is heavily focused on two villages in North Seram and two villages on the island of Boano in West Seram, we also observed development impacts in numerous other villages between and around North and West Seram. In each of our focus villages we held three group discussions, purposively selecting participants from the village to achieve maximum diversity. We held separate discussions with community leaders, including administrative, traditional and civil society groups. Additional information was gathered through informal interviews, using appreciate inquiry (Cooperrider and Srivastva, 1987). Specific activities conducted in each village are outlined in Table 1. Where appropriate, we have withheld names and identifiers to protect anonymity.

Our transdisciplinary research team is comprised of people trained in anthropology, aquaculture, conservation planning, environmental engineering, environmental economics, forestry, marine ecology, macroeconomics, microeconomics, and terrestrial ecology. Techniques were selected to help define theory of place and theory of change (van Noordwijk et al., 2015). We sought to understand "who and what" was driving change and "when and where" change was occurring. The results and discussion are informed by the data collected using methods described in Table 1 and our ongoing engagement with institutions and civil society in the Seram landscape. We sought to answer whether governance arrangements are effective in providing pathways to sustainable and inclusive development in Seram.

Table 1: Stepwise methods used in this study

Step	Method	Source	Activity
Spatially Explicit Inventory *From generic landscape theory of change principles, see **Sayer et al. (2016)**.*	Historical Trends Analysis	Local communities	FGD in 4 villages
	Actor Network Analysis	Relevant institutions	Interviews with institutions at multiple administrative levels (n=30)
	Resource Use Analysis	Local communities	FGD to prioritize resource issues in 4 villages, see Boedhihartono (2012)
	Biodiversity data	Existing literature Relevant institutions	Evaluation of marine and terrestrial threats, data gaps
Evidence for tradeoffs	SWOT	Local communities Local institutions	FGD in 4 villages Interviews with institutions (n=2)

	Economic analysis of principle sources of income	Local communities	Interviews in 4 villages, (n=80)
Building consensus	Theory of Change	Local communities Relevant institutions	Workshops (1 in village, 3 in province)

Results and Discussion:

Investment

There are divergent visions of desirable development between levels of government, between sectors of government, and between government and civil society. The head of investment in central Seram district (Badan Koordinasi Penanamam Modal, BKPM) has a vision for Seram as a hub of industrial growth for eastern Indonesia. This aligns with the national strategy for accelerated economic development (MP3EI) (Indonesia's Kementerian Koordinator Bidang Perekonomian Republik, 2011). The head of the BKPM envisaged growth driven by mining, oil and gas, oil palm and other estate crops, and industrial fishing; he insisted that "any investment is good investment" and his office was clearly focused on development benefits and not environmental impacts. He believed that existing, lingering customary land tenure and ownership arrangements are an obstacle to large-scale investment. He saw the national park as an obstacle to infrastructure development and restricting space for more industrial activity. He also saw lack of coordination among government sectoral agencies as an obstacle to doing business in Maluku. The national park office recognizes that communities around the park boundaries are poor and the park director was seeking opportunities for integrated conservation and development partnerships. Any development inside national parks is prohibited in Indonesia. However, on the border of the national park, areas zoned as conversion forest or non-forest estate may be used for investment. We concluded that there is opportunity for enhanced relationships between the investment and conservation sectors in the landscape which includes the national park to ensure conservation occurs alongside development.

Until now, most people seeking licenses for commercial or industrial operations are in the fishing industry – the majority of 71 industrial permits issued are small and issued to small and medium fishing enterprises. The licensing office expects a greater increase in the number of large-scale investment permits as tenure and ownership agreements become clearer.

We learned of four major investments driving change in northern Seram, identified in Table 2. As resource-based investments, they have the potential to transform the area in Seram. Our interviews indicate that investments are not delivering expected local benefits and are raising concerns among local communities over environmental harm. In addition to the major investments identified, we observed a new logging concession adjacent to Wahai in North Seram. The concession is held by Talisan Emas and is a 30-year selective-logging lease (Hak Pengusahaan Hutan, or HPH) bordering the national park and centered on a village named Solea. The logging concession covers 54,750 hectares of a 69,000 hectare Forest Management Unit, the Wae Sapelewa Kesatuan Pengelolaan Hutan (KPH). The Forest Management Unit is not yet fully operational and suffers from a lack of funding. A private

log-loading facility was constructed in 2018 on the coast to the East of Wahai with 3 hectares allocated for expansion. There are no facilities for processing timber and we were informed that the logs were being taken to a plywood mill on Buru Island. The logs were of a diversity of hardwood species and mostly of intermediate diameter from 0.5 to 0.8 m.

New logging roads are being built into the forest adjacent to Manusela national park. We observed logging that did not adhere to national logging regulations, including logging on steep slopes. Local people reported increased water pollution following logging in nearby forests, although the water has not been tested. We were concerned that logging may degrade the forests to the extent that they will eventually be reclassified as conversion forest, and classed as 'other use land' and transformed into estate crops following the Indonesian pattern of 'deforestation for development' (Barr and Sayer, 2012). Our concerns are reinforced by local reports that in the 1990s, Bob Hassan, an Indonesian businessman convicted of corruption due to his ties with former President Suharto, was awarded a 192,000 ha forestry concession for a plantation forest estate on Seram. The concession was cleared of forest but never planted. It was subsequently occupied by transmigrant farmers. These patronage awards are unlikely to take place following 1998 reformation and decentralization. However, research conducted by CIFOR, Liswanti (2012) raised concerns that local visions of development in Seram are not accommodated by top down decision-making processes. As concessions continue to be allocated along the northern coast, it appears nearby villages are deprived of access to land yet receive few significant benefits.

Table 2. Large scale investments and development initiatives in Seram

Type	Information	Implication for sustainable development
Oil and Gas, CITIC – Seram Energy Ltd.	Supported by the China International Trust and Investment Corporation. Quoted on the Hong Kong stock exchange. CITIC is a joint venture with Indonesia with Japanese and European partners. Estimated production is 4,500 barrels of oil per day.	**Tension between company and local communities** Company-wide only 5% of employees are Indonesian. The Eastern Indonesian Labor Federation reports CITIC Seram Energy for violating labor rights of local workers. **Profits from oil and gas are not staying in Seram** New contracts as of 2018 extend the production of oil for an additional 20 years until October 2039. CITIC Seram remains the operator of the Seram Block and will hold a 41% interest. As is standard across Indonesia, taxable profits from oil and gas do not flow to provinces, they flow to the central government.
Cacao Plantation, OLAM	5000 ha plantation. Near Manusela National Park. Nearby villagers obtain daily paid jobs on the estate.	**Unfulfilled potential for much needed agricultural extension** OLAM has publicized their local Seram operation as serving the needs of local smallholders and for progressive corporate social responsibility. The company does not buy from local smallholders. Some local people prefer to work for the company for higher income than they obtain from managing community forestry plots. Local communities growing cacao have not received any extension service or been integrated into a cooperative arrangement as 'out-growers'.
Prawn Farm, current ownership unknown Chinese investor, previously Nissui Indonesia, subsidiary of Nippon Suisan, Ltd).	Operations are near to Sawai. The integrated prawn production line has been operating since 2004 but has now closed because of disease problems. Since being acquired by a Chinese investor, it is said to be on the verge of reopening.	**Inadequate environmental impact management** Environmental actions are perceived locally to have negatively impacted on their marine based livelihoods. Locals complain of mismanaged waste runoff from the farms and of boom and bust hiring cycles of the processing plant (poor job security). **Lack of local inclusion**

		There is no policy to hire local people, we were informed that most employees are Javanese, Butonese, or Bugis migrants or otherwise non-local. Locals have lobbied unsuccessfully for jobs with the company.
Oil Palm, PT Nusa Ina	Two blocks, totaling 30,000 ha of oil palm have been developed, split between East and West Sawai. The processing mill is in the East.	**Failure to consider local legislation and environmental safeguards** Local communities have rallied against PT Nusa Ina for not adhering to good environmental and social practices. The company has been accused by local media of clearing land in places where they did not have permission, breaking environmental safeguards (Maluku Post, 2017).

Bridging traditional and State resource governance

Current Indonesian natural resource management policies are increasingly recognizing and integrating traditional and local natural resource governance arrangements. We saw evidence of this on the remote island of Boano, on the North West coast of Seram. The island is divided among nine clan groups, called Soa. And, as is common around Seram, Christians and Muslims live in separate but adjoining communities. The Soa claim rights to two halves of the island– the northern half for 5 Muslim Soa, the southern half for the 4 Christian Soa. The Muslim north is more densely populated with approximately 12,000 people and 1,000 people live in the Christian south.

A local NGO, Lembaga Partisipasi Pembangunan Masyarakat (LPPM), has been working on Boano to revitalize traditional sustainable resource-use practices. The NGO aims to assist the integration of formal state and local government arrangements and encourage local livelihoods to become more integrated with external markets. The NGO is working to ensure clan groups can agree that excessive natural resource use is a problem that must be solved. Our observations support their claim that all clan groups agree that natural resource management is a problem and that external regulation will be needed to enforce agreements. There is a high degree of territoriality based on legacies of traditional tenure arrangements, where Soas determine land-use and natural resource allocations. Currently, this system does not align with State delineation of land. The district and provincial spatial plans show 'protected forest' (hutan lindung) covering the center of the island, whereas local Soas delineate land based on a mix of cultural heritage and resource criteria.

These resource tenure arrangements and development pressures are characteristic of a tragedy of the commons, as seen across other parts of Seram (Tjoa et al., 2018). De jure maps and legislation do not reflect the de facto resource allocations and use, described below. A key issue on Boano is the significant portion of livelihoods dependent on land classified as Permanent Forest Estate. Much of the official 'protected forest' is farmed for monocrop melaleuca oil (Melaleuca cajuputi). Melaleuca trees are owned by families, who harvest wood from nearby forests as fuel for their cajuputi oil stills, and to fence their gardens to protect them from wild pigs. The production of Melaleuca oil is the main economic activity on the island but the government does not receive any of the production tax – it is an informal economy taking place within Indonesia's protected forest estate. Local people sell their product to intermediaries for a low return and with high risk. Legitimizing production could raise incomes for the island's poor inhabitants, but it would require de-gazetting State forest land. An alternative would be to delineate the forest as community forest land under one of Indonesia's Social Forestry schemes (Fisher et al., 2018).

Creating resource governance arrangements that incorporate formal and local structures could offer the people of Boano a strategy for continuing the production of melaleuca oil while enforcing natural resource management. The Soa groups recognize that forests are degrading as a result of excessive firewood harvesting but struggle to see a viable solution. Declining soil productivity and degrading forests jeopardize the long-term future of the people. Local enforcers of traditional natural resource management called Kewang are not able to fulfil their duties as their authority is not yet recognized by the Government. The Kewang do however collect fees in the form of 'tax' from local people who are producing melaleuca oil and these fees support the Soa system.

> *"Kewang let us do what we want, all they do now is collect fees from us to pay the Soa a tax on our production." – Cajuputi farmer*

Boano culture prevents Soas from explicitly indicating land boundaries, and Soa heads are hesitant to formalize their land boundaries. Yet the island community is gradually becoming open to outside interventions, recognizing they may benefit from government infrastructure programs.

> *Simply, it has been too long since anybody has paid attention to us and our needs. We must develop for ourselves, but we cannot do it alone – the government and outside economies must allow our participation. – local villager*

Governance arrangements could build upon traditional local practices and empower the local communities by incorporating their in-depth local knowledge into legitimatized local Soa arrangements. Government regulations should therefore be of a generic nature, allowing space for the emergence of diverse local governance arrangements. In several publications Ostrom has argued for multiple locally derived models for local natural resource governance (Ostrom, 2007, Ostrom, 2009, Nagendra and Ostrom, 2012). Integrating State governance with local governance on Boano should start with gathering information on how local governance supports natural resource management, and how communities wish to manage their natural resources in the future. This information could then be used to determine how local governance can be empowered and legitimized through formalized regulatory frameworks.

Strengthening existing institutions

Governance challenges also emerge from overlapping mandates of local government institutions. In our discussions with local communities, we were informed of dissatisfaction with many local government administrators. Formal village systems have replaced local arrangements, creating tensions between clans who cannot agree over who should take formalized leadership positions. Historically, local governance was often an arrangement of rotating leadership according to locally derived norms. Currently, temporary heads of villages have been assigned rather than elected, and in some cases lack authority. In some of the sites we visited, communities identified corruption as an issue, as financial resources that flow from the central government to the village level are not properly accounted for by temporary village leaders.

As elsewhere in Indonesia (Riggs et al., 2018), government institutions lack the resources and capacity to effectively support locally diverse and complex land management systems. The office of Inspektorat (audit office) located in the district capital, Masohi, is understaffed and lacks the capacity to monitor and enforce accountability for local development funding.

> *"There are about 40% well accounted for village funds. If there is reported corruption, we are supposed to investigate and submit reports to the law enforcement agencies – there is too much to track down. We do not have enough people, money, or capacity to account for the development funds being distributed." – Inspektorat officer*

The government village empowerment office is responsible for administering village development funds (termed Dana Desa in Indonesian). These funds are intended to boost local entrepreneurship and empower local decisions over development investments. The Dana Desa is meant to harmonize local development needs with national development strategies. However, the office responds to top-down instructions, and is not responsive to bottom-up decision making (Sutiyono et al., 2018). One major objective of the office is to deliver and monitor the United Nations Sustainable Development Goals through the village development funds. The effect of this is that investments in the SDGs do not align with local needs.

> *"Many of the villages must be told they are poor, we have to start socializing them to their problems and then we help them establish village owned enterprise cooperatives with the development funds". – Village empowerment officer*

In Seram, historical conflict has strengthened local resolve to manage their own resources for their own current well-being. However, it is our observation that conflict did not contribute to strengthened cross-sectoral or robust linkages between local and state governance regimes, as can sometimes occur (Langston et al., 2015). Similar issues have risen across Indonesia, as slow progress in devolving control to the local level inhibits effective implementation of development programs, weakening governance structures (Afifah et al., 2017, Sutiyono et al., 2018). Indonesia is making significant progress to decentralize decision making that might better address rural poverty, but new responsibilities must be supported by capacity building and strengthened local management institutions to carry out these responsibilities (Boedhihartono, 2017). Given the recent and dynamic nature of governance shifts it is too early to evaluate, with certainty, the success of these programs.

Shifts from top-down approaches

Most villages we visited are involved in some form of social forestry, these include community forests (Hutan Kemasyarakatan, HKM), village forests (Hutan Desa, HD), or customary forests (Hutan Adat, HA). These initiatives aim to empower social groups to manage their forests for local sustainable development, while simultaneously aiming to achieve conservation outcomes (Moeliono et al., 2017). However, social forestry is not a panacea. Indonesia's social forestry programs have yet to deliver the rights and empowerment that many had hoped for (De Royer et al., 2018, Moeliono et al., 2017). Social forestry is an advance on the Indonesian government's historical command and control approach to forest management but there is still progress to be made (Fisher et al.,

2018). The social forestry initiatives we observed appeared to be imposed and to be based on a simple centrally determined model. Areas proposed for the designation of social forestry did not match local land use arrangements, causing confusion amongst villages. In one of the sites we visited, extension work was meant to contribute to innovative, more profitable agroecological practices. Yet the farmers were either not adequately trained or did not see value in the new practices; the scheme was not receiving local support.

To be socially and economically viable, social forestry schemes must provide profits for local farmers. Speaking with new members of a community forest, farmers perceived the scheme as beneficial to their livelihood security. The community forest provided dietary and economic benefits however, farmers felt benefits from the community forest were marginal in delivering of meaningful development outcomes. Working as laborers in neighboring estate crop companies, including oil palm and cocoa plantations, provided more benefits for farmers than managing community forestry plots. They preferred employment in industrial cropping companies, which offer higher incomes and opportunities to diversify and expand livelihoods for future generations.

Social forestry could help legitimize existing forest use rights on Seram. Ellen (2007) hypothesized that Indonesia's expanding scope of social forestry and recognition of local voices and community rights in Seram would give value to local ecological knowledge. But currently it is not clear how social forestry will contribute to solving large-scale development challenges (Bong et al., 2019). In Indonesia, forestry departments are one of the most important agencies in decentralizing state power (Ellen, 2007). Social forestry in various forms is being promoted by forestry departments around the world (Moeliono et al., 2017). Yet if they fail to take into account diverse local contexts social forestry can exclude some rural people (Moeliono et al., 2017).

Future of Seram's forest landscapes

Seram contains some of the last large tracts of land available in Indonesia for agricultural and estate crop expansion. There are numerous reasons why it is attractive to investors. Seram's population density is sparse, reducing the severity of tenure conflicts with new investors. Much of the land is fertile and because of road developments, lowland rainforest is becoming more accessible. Regional spatial plans and district permitting offices indicate that they are open for business. Indonesia's major spatial development initiative, the 'accelerated economic master plan' for 2011–2025 centers on economic integration through coordinated investments in hard and soft infrastructure. Government policy is to connect the more remote and poorer parts of eastern Indonesia to the developed west of the country (Indonesia's Kementerian Koordinator Bidang Perekonomian Republik, 2011). Seram is on the brink of engaging with economic development on a scale that will transform livelihoods and the environment.

Estate crop, mining, and oil and gas companies are criticized for their lack of contribution to local economic needs, however previous Indonesian studies show that local people may perceive them as attractive (Langston et al., 2017, Langston et al., 2015, Feintrenie et al., 2010, Pirard et al., 2016). This is unsurprising considering the growing expectations for

improved material wellbeing and the limited alternative development options available to remote rural communities.

Engaging with villages in north and west Seram, we observed that traditional governance structures, which have previously remained intact, are struggling to coexist with formal government arrangements. Conservation and development priorities set by the central government are in conflict with existing management practices. Diverging visions, gaps between formal and informal governance structures and vestiges of top down planning is limiting participation of local institutions in decisions that will determine the future of the island's inhabitants. Horizontal and vertical disconnects inhibits the emergence of new management arrangements can better meet the interests of diverse actors in the landscape. As an emerging island economy, opportunities are rising for institutions to evolve for better coordination between formal and informal governance structures. Recent examples in Indonesia show NGOs and researchers can facilitate interactions between communities, government and private actors necessary to drive collaboration and communication for improved natural resource stewardship (Ruysschaert and Hufty, 2018, Fisher et al., 2017). Early involvement of local communities in decision making will be integral to this process, made possible by the willingness of investors and government to deliver local benefits (Langston et al., 2019).

Conclusion

How and when locals are involved in decision-making processes is critical for ensuring inclusive development. Conservation cannot succeed alongside exclusive developments that marginalize people (Gupta et al., 2015). People must have their rights recognized, rather than allocated (Moeliono et al., 2017). Local governance systems that are disconnected from decisions made at higher scales mean local communities are unprepared to capitalize on inclusive development opportunities, should they arise. On Seram, vertical integration of organizations bridging formal and traditional governance will be necessary to ensure decisions benefit social and ecological components of the Seram landscape. Organizations interested in influence the conditions for sustainable development must not impose solutions. They can influence the constellations of networks and bridge gaps between traditional and formal governance, leading to adaptive institutions that serve the interests of local people. The opportunities for local governing organizations to intercept large scale investments are large. Current efforts to connect and harmonize visions of development are a positive step toward the possibility of inclusive development in Seram. If these governance arrangements allow the major drivers of change to contribute to development alongside more experimental social forestry and community development activities, then Seram might be a lodestar of development for eastern Indonesia.

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Chapter 6: Science embedded in local forest landscape management improves benefit flows to society

Science Embedded in Local Forest Landscape Management Improves Benefit Flows to Society

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There is a global shift of forest management to local levels to better reconcile local livelihoods and biodiversity conservation. We argue that achieving such outcomes will require embedding science in landscape-scale management systems. We show that science can contribute to local learning and adaptation within landscape contexts. Complexity and power relations have hampered scientists' efforts to engage with the people who use and influence the use of resources at landscape scales. Landscape approaches present an opportunity for science to help steer local management to address local contexts. We have conducted research at the interface of policy and management at landscape scales. More effort must go toward transdisciplinary approaches to co-generate knowledge and create "Communities of Commitment" for continual learning and adaptation amongst landscape-scale actors. Embedded science incorporating local knowledge and contexts and engaged in landscape scale development processes is necessary for improving decision and policy-making.

Keywords: landscape approaches, sustainability science, conservation science and society, research in development, local management, transdisciplinary action-research

INTRODUCTION

Place-based sustainability science and transdisciplinary research have contributed to a better understanding of development processes (Mauser et al., 2013; Balvanera et al., 2017). Understanding that the environment, society, and economics are dynamic and inexorably linked is the foundation of scholarly interest in social-ecological systems (Guerrero et al., 2018). The links in systems, identification of system tipping points, and ways to achieve more sustainable transformations must be understood if science is to foster more sustainable and inclusive development (Wiek et al., 2012). However, despite a proliferation of initiatives, the adoption of a social-ecological systems perspective is far from delivering on its potential, especially in the dynamic forest landscapes of the tropics (Blythe et al., 2018; Guerrero et al., 2018).

The contexts for applied place-based transdisciplinary research are changing rapidly (Brondizio et al., 2016). Recently, sustainability science and transdisciplinary research have been applied to the management of social-ecological systems. This embedded and applied research has enriched narratives of "who" decides what the problems are and "who" provides solutions and at what scale (van Noordwijk, 2017; Blythe et al., 2018; Opdam, 2018). The changing contexts lie in

global shifts to decentralize forest management and to acknowledge and legitimize local forest rights (Persha and Andersson, 2014; Fisher et al., 2018). In the tropics, forests allocated for local community management are expanding more rapidly than those allocated for strict protection. Nearly a third of forests in developing countries are now under some form of local control, more than twice the area allocated for strict protection (Chape et al., 2005; Schmitt et al., 2009; Peres, 2011; Rights and Resources Initiative, 2014). The UN Declaration on Forests and the Tropical Forest Alliance explicitly advocate community management to avoid deforestation. The following quotes illustrate the enthusiasm with which development and conservation organizations support this shift in management.

> "There is no better way to ensure the careful stewardship of [forests]—whether in the Amazon basin, the Andean highlands or the jungles of Central America—than to give indigenous communities full control over the land"
> Moreno (2016) (President of the Inter-American Development Bank).
> "Community control of forest lands is a gift that keeps on giving"
> Union of Concerned Scientists (2013).

Inclusion of local people is required to satisfy global commitments to sustainable development as expressed by the 2030 Agenda for partnership, people, planet, peace, and prosperity (Colglazier, 2015; Gupta et al., 2015). To exclude local people would be to deny their human rights and the strong relationship local people have with their environments (Berkes, 2004; Liu et al., 2007; Inman, 2016; Langston et al., 2017). A rich history of analysis of local governance and resource stewardship has informed decisions and policies to acknowledge and legitimize localized resource management regimes (Nagendra and Ostrom, 2012; Ostrom, 2015). Local management regimes are highly diverse (Gilmour, 2016), from passive participation in programs, along a spectrum of increasing engagement to full active control. Recognition that the fate of forests ultimately lies in the hands of local people is driving the process of decentralizing management (Singer and Giessen, 2017). However, recent studies on locally managed lands raise uncertainty about their contribution to meeting global conservation goals. This in turn raises the question over how science can best contribute to achieving sustainability and inclusivity of social-ecological systems management (Robinson, 2006; Sikor, 2006; Wiersum et al., 2013; Jong et al., 2015; Schusser et al., 2015; Bhagwat and Humphreys, 2017; Sayer and Margules, 2017).

Contemporary science is slowly embracing sustainability science based on collaborative, transdisciplinary approaches and social-ecological systems thinking, and is working at the landscape scale to make impact (Opdam, 2018). Yet large disconnects between local realities, conservation science and practice, and global policy discourses suggest an unmet need to science Robinson (2006); Boedhihartono et al. (2018); Bull et al. (2018). Global environmental discourses justify policy interventions that do not harmonize with local realities (Adger et al., 2001; Bull et al., 2018). Policy emerges from narratives

and discourses rather than from objectively weighed evidence (Pawson, 2006; Shanahan et al., 2011). Science must engage influential actors and knowledge systems to influence narratives at the scale at which interventions take place.

In this paper, we describe the use of embedded science to influence narratives in a direction that increases commitments to sustainability. We define embedded science as the cogeneration and integration of knowledge across disciplinary boundaries, into the pre-existing actor networks that affect landscapes. Landscapes are considered social-ecological systems, delimited by a set of locally identified problems (Sayer et al., 2013; Opdam, 2018). Our cases draw on concepts from place-based transdisciplinary research and sustainability science (Lang et al., 2012; Brandt et al., 2013; Balvanera et al., 2017). As governance complexity increases and local management regimes are more widespread, we strategically position our science to co-generate the knowledge needed to make effective management decisions at local scales (Mauser et al., 2013).

Embedded science heeds the call from van Noordwijk (2017) for research "in" development. Research in development is conceptually different to research "for" development or research "on" development (Coe et al., 2014). Research on development implies separating the researcher from the subject, research for development is a more linear pass-the-baton approach (Thornton et al., 2017). Embedded science or research "in" development is collaborative and supports the co-generation of knowledge with a full range of disciplines and partners. Embedded science requires that researchers have a "seat at the table" alongside the actors who debate policies and programs.

The recent trend toward local management provides an opportunity to examine relationships between science, policy, and management. Local management creates the need for effective multi-level and polycentric governance (Bixler, 2014; Alexander et al., 2016). In this paper, we describe challenges and opportunities for co-generating knowledge with the multiple actors that influence local decision-making (Lang et al., 2012; Polk, 2014). We show that scientists must be flexible, reflective, and reflexive in their roles and approaches if they are to influence the ways in which local management regimes deliver conservation and development impacts (Evans et al., 2017; Boedhihartono et al., 2018; Ros-Tonen et al., 2018). Finally, we identify some practical methods to embed science and describe lessons from our work as part of our approach to conducting research in development, rather than on development.

CHALLENGES FOR EMBEDDED SCIENCE

Governance processes that move the locus of control to the community level may divert attention away from the need to manage for public goods values of forests such as biodiversity and stored carbon (Ostrom, 2015). If landscapes are going to deliver the multiple services required of them (Fischer et al., 2017), conservation and development organizations must be receptive to knowledge from the full range of disciplines (Wiek et al., 2011). Currently, we observe that there is too little commitment by scientists to gaining the understanding of local contexts required

to create the knowledge to place forest landscapes onto more sustainable trajectories (Chambers, 2012).

> *When researchers position themselves strategically within landscape management processes and adopt an action-research approach, they can gather data and influence the process at the same time. In this way, research can help meet the needs of practitioners and policymakers, while practitioners and policymakers will help in answering relevant research questions* (Kusters, 2015).

Effectively embedding science is impeded by the rigidity of institutions that conceptualize and transfer scientific knowledge. We classify these challenges into four domains; system complexity, epistemology, institutional stickiness, and power distributions. We identify how science can better address these challenges in forest-landscapes.

Complexity

Complex institutional arrangements that struggle to resolve trade-offs between conservation and production are the norm—conflicts of interests are inherent in forest landscapes. For instance, local people asserting their rights to self-determination often consider that their short-term needs to clear forests for agriculture or to hunt and log in forest areas have greater legitimacy than externally imposed conservation goals. This complexity is rooted in the how landscapes are socially constructed; they have unique spatial "identities" (Davenport and Anderson, 2005; Massey, 2005). Landscape identity and distinctiveness is shaped not only by externally perceived functions, but also by the social and cultural capital of a landscape's inhabitants, which is reproduced through stories and memories (Buizer and Turnhout, 2011). As technological developments and socio-cultural contexts change, these traits are not static. Landscapes are therefore sites of subjective experiences which are constantly evolving (Arts et al., 2017). For scientists aiming to influence landscapes, the complexity and history of "territorialization," or processes by which culture and nature interact and co-produce landscapes (Horlings et al., 2016), merits greater attention. Akin to people learning languages, scientists can benefit from immersing into place, to be conversant with local discourses that shape and influence place.

Scientists need to understand the institutionalization of cultural phenomena in landscapes. These are the rules that determine modes of operating—including the routines, organizations, and ways of cooperation through which landscape governance operates (Arts et al., 2017). Governance arrangements are polycentric and often emerge through "institutional bricolage" (Cleaver, 2017). This complexity alone demands different patterns of scientific engagement in different locales. Scientists can become part of networks of influence and define problems in partnership with those whose behaviors they seek to change.

"Context is everything" (Sayer and Margules, 2017). Place-based approaches recognize that complexity manifests in the diverse and changing perspectives people hold of their place. A seeming paradox of place-based science is that there are no generalizable findings due to the complexity of places. Results from a study of one landscape are rarely transferrable to another landscape. There are not enough resources—scientists, funds, and time, for place-based science in all locations. Yet this complexity is precisely the reason that embedded science is needed.

The transferability components of embedded science are the ways in which hypotheses are developed and tested, and the analytical methods adopted. As such, embedded science is about getting the questions (or hypotheses) right and improving methodological applications to influence the narratives and power distributions that steer decision making within a landscape. The present movement to hand over forest management to communities without ensuring that appropriate mutual obligations, governance arrangements, and checks and balances are in place could lead to a depletion of forest biodiversity (Laurance et al., 2011; Langston et al., 2017; Terborgh and Peres, 2017). Local forest management initiatives that are not rooted in fundamental principles of sustainable forest management and do not harmonize with local governance arrangements and capabilities risk failing to achieve socio-economic or ecological gains.

Epistemology

Policy makers and implementing agencies do not make decisions based primarily on evidence (Mintzberg and Westley, 2001; Pawson, 2006). Rather, they make decisions based on the narratives formed in the social and political networks in which they operate (Keeley and Scoones, 2014). This can result in "policy-based evidence" (Marmot, 2004), wherein implementing agencies allocate resources based on the agendas of those with whom they communicate, share knowledge or perceive as influential. Similarly, we know that scientific findings do not usually "fall on blank minds"; instead, science interacts with occupied minds that have strong views about how things are and should be (Marmot, 2004; van Noordwijk, 2017). Funding constraints may compromise the scope of scientific activities that are possible and further bias strongly held views, reinforcing the narratives emerging from their research (Wunder et al., 2008; Redford et al., 2013).

Scientists are often not sufficiently epistemologically agile (Haider et al., 2018) to maintain and bridge dialogues between policy makers and implementing agencies. Forest landscapes are complex social-ecological systems that demand collaborative transdisciplinary problem framing (Brondizio, 2017; Law et al., 2017; van Noordwijk, 2017). Inflexible epistemology is an obstacle if science is to engage effectively with the multiple knowledge systems interacting with diverse actors that operate at local levels (Chambers, 2014b). There is an enormous diversity of epistemological and ontological traditions affecting the exchange and translation of information. Berkes (2012), in a review of the philosophy of science, stylizes ontological differences between local knowledge and western science. He characterizes local knowledge by human-nature inseparability, subject, and object inseparability, and experiential learning. In contrast, he characterizes western science as compartmentalizing variables and relying on reductionist experimental learning. Compartmentalization of different components of earth systems is manifest in multiple ways that societies function, none more so than in the ivory towers of academia.

The relative legitimacy of natural vs. social science and qualitative vs. quantitative information continues to divide disciplines and inhibit progress (Sunderland et al., 2007). Questions of what entails legitimate knowledge present challenges for how academia engages with the non-disciplinary domain of conservation & development (Pressey et al., 2017). In terms of sustainability, different disciplines have coalesced around discourses of resource rights, human justice, inclusivity, and environmental sustainability (Nijnik et al., 2014; Cashore et al., 2016; Riggs et al., 2016; Dawson et al., 2017; Humphreys et al., 2017). However, "traditional analytical frameworks," where ontologies are static and linear, are a weak tool for solving complex problems in landscapes (Duit et al., 2010). Landscapes are heterogeneous and scientific engagement should legitimize and integrate with multiple actors, knowledge systems, stakeholders, and decision-makers (van Noordwijk, 2017). Transdisciplinary research in sustainability science offers opportunities to mobilize scientific capacity in a more democratic way (Brandt et al., 2013).

More obstacles to knowledge integration lie in collective human cognitive capacity. Behavioral scientists show that the more nuanced messages do not get the same traction as simplistic statements due to deficits in today's attention economy (Davenport and Beck, 2001; Tufekci, 2013). Rapidly expanding knowledge, and the increase in misinformation and disinformation compete for attention (Chambers, 2014b). Thus, attention is restricted to sound-bites, simplistic, and polarized messages (Ciampaglia et al., 2015). Rapid technological growth is testing societies' cognitive abilities to sift through vast amounts of information to comprehend the nuances surrounding issues (Friedman, 2017). Scientists face similar difficulties; the sizeable growth of peer-reviewed literature over the past decades means scientists may overlook papers contributing to more nuanced understanding of their fields (Courchamp and Bradshaw, 2017). This contributes to narratives that steer decision-making that are contradictory or disconnected from complex realities.

Institutional Stickiness

While concepts and calls for collaborative science to deliver societal learning are not new, their efforts have been hindered by institutional stickiness; the inability for new institutions to take hold in a setting of suboptimal institutional arrangements (Hajer, 2003; van Oosten et al., 2017). Organizations have thus far been too conservative in their approach to both partnering locally for the co-generation of knowledge and to sustaining natural resources (Sundar, 2000). Their bureaucratic institutional inflexibility, with myriad compliance requirements, inhibits the creation of innovative relationships and networks that influence system wide learning (Scheba and Mustalahti, 2015). Furthermore, high transaction costs of inter-institutional coordination lead to fragmented governance; many conservation and development organizations work side by side but with minimal cross-scale and cross-sectoral communication (Giessen, 2013; Gallemore et al., 2015; Sahide and Giessen, 2015; Riggs et al., 2018a). Collaborative management initiatives must avoid top-down control and instead be based on a platform of power equality (Sundar, 2000).

Transdisciplinary teams are subject to funding constraints (Wunder et al., 2008). If funders require deliverables framed by institutions that are not rooted in local contexts, bottom-up problem framing will be hard to achieve. Harmonizing work to local realities must involve changes in donor behaviors so that downward accountability is mainstreamed (Ebrahim, 2003). To achieve this, leadership in organizations that deliver funding can promote deliverables that include rigorous diagnoses of the social-ecological systems in which the work is to take place. Research questions should be included and aimed at strategizing how the organization can better embed their work inclusively and appropriate to local development settings, needs, and aspirations.

In the 1990–2000s, adaptive collaborative management (ACM) received attention for its potential to deliver better social learning outcomes for governing complex social-ecological systems (Armitage et al., 2009). ACM is a process where multiple stakeholders bring together their different knowledge, experiences, perspectives, values, and capacities to communicate and critically reflect to understand and address common concerns (Khadka and Vacik, 2008). It acknowledges that reaching consensus on what the problems are and acting to implement policy decisions requires change in multiple actors in any given social-ecological system. Better coordination requires an understanding of the value systems of these actors and searching out intersections of interests. Negotiating around these intersections of interests must be incorporated into decisions about the future (Biggs et al., 2011). In many cases, required behavioral changes must emerge from decisions made by local resource users, but will also include changes in government policies and programs and changes in investments made by the private sector. In order to promote change in all of these actors, it is necessary to understand the values and motivations of decision makers and to communicate with them (Bennett et al., 2017). Too many scientists see the challenge of communication as being the challenge of delivering a message to decision-makers based on the results of their research; one-way communication telling decision-makers the results of studies. In fact, the challenge for scientists is to listen to and learn from the people who might benefit from their research.

Many organizations prioritize scientific methods based on the "gold standards" of randomized controlled trials, which, in complex dynamic landscapes, can mislead or fail to provide the evidence upon which conservation decisions should be made (Agrawal, 2014). We join others who observe how projects and externally planned conservation initiatives might displace landscape management capabilities based on long periods of unstructured experimentation or trial and error, which may be more likely to lead to conservation success (Hodge and Adams, 2016; Pressey et al., 2017). Experience suggests that global policy and decision-making institutions need to build their collective resilience through more learning-based and flexible approaches that draw on diverse and collective wisdom (Fisher et al., 2017). Effective governance includes the transfer of authority, transparency, and upward and downward accountability, and much of this hinges on knowledge dissemination (Khatun et al., 2015). This does not mean outcomes will be predictable

because local contexts demand different decisions and management interventions.

Power Relations

Local power arrangements are difficult to understand, and it may be difficult for outsiders to engage with them. To locals, poor-transparency and corruption in resource allocation decisions occur when opaque governance arrangements inhibit accountability. Power arrangements are the determining factors in who decides local landscape conservation and development outcomes. Embedded science must deliver where traditional science has not—in the failures to engage people, especially those people who live in, use, or otherwise influence the use of resources where sustainability outcomes are at stake (Mcnie, 2007; Knight et al., 2008). Power distributions must be confronted, understood, and dealt with if science is to make any difference (Riggs et al., 2018b).

The exclusionary nature of professionalism and entrenched rigid bureaucratic policies promote compliance over systemic learning (Green and Lund, 2015). Donor organizations and project planners have prioritized formalizing joint management processes, leading to a "professionalization" paradox (Lund, 2015). Professionals are seen by locals as external experts who micromanage local efforts by setting up multiple participatory committees, which often do not align with local expectations for the future (Scheba and Mustalahti, 2015). We see ongoing failures from professional experts meeting donor requirements by handing over knowledge they believe should be used to implement change, re-creating the flaws of formally planned and highly modernized science endeavors (Mintzberg, 1994; Scott, 1998).

Participatory action research aiming to underpin collaborative management has been beset by problems characterized by a tyranny of participation. Promoters of participatory methods claimed that participation would challenge hegemonic practices by empowering development beneficiaries to determine the direction of change (Enns et al., 2014). Participation can be misused—a social tool turned into a social weapon. While participation began as a counter-hegemonic concept, it has been used in "very hegemonic ways" (Enns et al., 2014). In their book Participation: The New Tyranny? Cooke and Kothari (2001) argue that participatory schemes often fail to engage with issues of power and politics, depoliticizing what will always be political processes. Further, there have been numerous cases where collaborative schemes serve to legitimize decisions already made, resembling the "we manage, you collaborate" approach, or where participation is used by organizations to make their projects and activities more cost-effective by drawing on communities' own resources (Gaynor, 2013).

Proponents of participatory approaches still assert that meaningful participation has potential to equalize power relations between intended development beneficiaries and experts (Kusters et al., 2018). If scientists are going to contribute to socially just power arrangements, they must avoid involving local actors simply to share operating costs. They must be proactive in paying careful attention to the existing cultures and practices into which their work is to be introduced and take precautions about how to interact with actor-networks of power and politics. There is inherent epistemic privilege associated with academia, and as such, the authors of this paper agree with recent pleas for better reflexivity among scientists (Popa et al., 2015). This includes understanding the need to cede control of problem framing and aim for contributions that redistribute power throughout the system for inclusivity and sustainability.

A WINDOW OF OPPORTUNITY

The recent and ongoing allocation of significant areas of forest to local management provides a window of opportunity for science to partner with local managers and co-generate knowledge. Multiple scholars are concerned that the present movement to hand over forest management to communities without ensuring that appropriate governance arrangements and science-based management regimes are in place could lead to the depletion of forest biodiversity (Laurance et al., 2011; Langston et al., 2017; Terborgh and Peres, 2017). "Local science" in its various forms is an important contributor to solving highly specific, context dependent problems (Danielsen et al., 2005; Sayer et al., 2015; Sutherland et al., 2015; Dawson et al., 2017). Local and indigenous knowledge should complement and be inter-woven (Tengö et al., 2017) with academic science, fostering transdisciplinary understanding of complex social and ecological contexts. In tropical forested landscapes, more often than not, conservation and development initiatives are still a top-down exclusionary process (Sheil, 2017). More frequently, local people assert their rights to self-determination and often consider that their short-term needs have greater legitimacy than externally imposed public good conservation goals. Co-generating knowledge will mean that they facilitate and are a part of the narratives and networks that influence change (Nel et al., 2016).

Opportunity also lies in the proliferation of landscape approaches (Reed et al., 2016). Society's biggest endeavors to reconcile conservation and development, and even more broadly to achieve sustainable development, are now claiming to use a decentralized landscape approach (Erbaugh and Agrawal, 2017). Landscape approaches are the current iteration of integrated conservation and development initiatives and have been conceptualized as a set of principles, guidelines, and tools for adaptive conservation (Defries and Rosenzweig, 2010; Sayer et al., 2013; Reed et al., 2016). Implementing agencies will not reach their goals by applying "cookie cutter" landscape approaches; science and the co-generation of knowledge will need to be embedded at the landscape level to ensure learning and adaptation leading to capacity building and an extensive cadre of local, naturally-embedded, science-based conservation practitioners. Landscape approaches attempt to tailor conservation to local realities and contexts, yet their impacts remain elusive (Sayer et al., 2016a; Reed et al., 2017). Additionally, they have been criticized for lacking rigorous conceptual frameworks (Erbaugh and Agrawal, 2017) and being used as a means of de-politicizing the problems apparent in social-ecological systems (Mccall, 2016). If these concerns

can be acknowledged and power politics and underlying narratives addressed head-on, landscapes can be useful arenas in which to experiment and learn about sustainability science in geographic spaces.

Decentralized forest management and landscape approaches offer a window of opportunity for embedded science, but there must be a willingness among scientists to do this. In the next section, we identify recent progress in overcoming challenges of embedded science and methods to foster more inclusive, sustainable development.

SCIENCE TO CO-GENERATE KNOWLEDGE

Emerging literature on how to contextualize sustainability science to be inclusive of the range of knowledge systems seems promising (Cornell et al., 2013; Mauser et al., 2013). Tengö et al. (2017) highlight five tasks science can undertake to be more inclusive of diverse knowledge systems: (1) mobilize, (2) translate, (3) negotiate, (4) synthesize, and (5) apply multiple forms of evidence. Their framework, by empowering and seeking to bring together diverse actors, explicitly links indigenous and local knowledge systems with science to inclusively enhance governance for sustainability. However, they claim that "tools and approaches that consistently enable engagement toward useable knowledge for all actors involved in these encounters are not yet available." We argue below that various tools including participatory simulation modeling, visualization techniques, and actor network analysis, are useful and can be deployed strategically so that science better embeds itself in local development processes. We assert, however, that more methods are needed to make sustainability science work in "places" in an inclusive way—where the science engages with diverse world-views, identities and ethics, and addresses rights and power asymmetries. There also needs to be more evidence of their effectiveness in achieving inclusivity and impact.

Butler et al. (2015) provide an example of how scientists might begin to co-generate knowledge using Participatory Systemic Inquiry. Their aim was to enhance adaptive capacity for change. They found that if the process is too researcher-driven, knowledge exchange and production is less effective. They suggest more participatory rural appraisal techniques to address local planning needs. Additionally, they suggest that more nuanced stakeholder analysis and measures to anticipate power dynamics are needed. We suggest that more up-front collaborative problem framing with the kinds of diagnostic tools suggested below might improve science, policy, and management relationships. Influencing policy decisions and their implementation will require changes in the behavior of multiple actors in any given social-ecological system. Thus, the value systems of these actors must be understood, negotiated and incorporated into decisions about the future (Biggs et al., 2011).

Theory of place is a conceptual framework to help scientists cope with multiple forms of knowledge, multiple actors, and power asymmetries in landscapes. It provides a set of useful diagnostic and reflective tools to interrogate the who, what, and where questions that can identify pre-existing inventories of

knowledge and narratives in landscapes (van Noordwijk et al., 2015). Theories of change frameworks can help grapple with the relationships in actor networks and processes that drive change. Rigorous theories of change can keep conservation science agencies on track and avoid displacement activities (Pressey et al., 2017). Simulation models and visualization techniques that explore alternative landscape scenarios can help challenge assumptions and make theories of change more rigorous and adaptable to changing circumstances (Collier et al., 2011; Boedhihartono, 2012; Sayer et al., 2016a) Generic theories of change for landscape level processes have been described elsewhere (Sayer et al., 2016a; Thornton et al., 2017; van Noordwijk, 2017). Used in a participatory and flexible way, they serve to clarify leverage points, where scientists can co-generate the knowledge that influences policy decisions and management outcomes. They also serve to identify learning points, where monitoring and reflection on the process can lead to incremental improvements in the system.

Recently Tschirhart et al. (2016) confirmed that peer to peer learning is effective and that effort should be put into identifying, and then strengthening, community owned solutions through peer-to-peer knowledge exchange. Policy, Social, and Actor Network Analysis (Jackson, 2010; Brockhaus et al., 2014; Gallemore et al., 2015) coupled with Actor Network Theory (Valverde, 2007) can provide insight on where scientists can situate themselves to co-generate the knowledge that will influence narratives and behaviors. A thorough understanding of the networks will allow for the identification of the charismatic leadership required for successful partnerships. Recently, Q-methodology has shown potential for uncovering underlying narratives where power and politics drive decisions (Mckeown and Thomas, 2013; Nijnik et al., 2014; Pirard et al., 2016; Amaruzaman et al., 2017). We think these frameworks, tools and methods can assist scientists to engage with the multiple actors and the preexisting multiple knowledge systems within landscapes. Data and data transparency are integral to enabling society to coalesce around knowledge narratives. Scientists must define problems in partnership with those whose behaviors they seek to influence with the evidence they will provide, and the landscape scale has emerged as a manageable entry-point.

Sayer et al. (2016a) show that landscape improvements in learning and adaptation come from process driven approaches geared toward incremental change, as opposed to outcome driven approaches aiming for transformations. In our experience, embedding and influencing actor networks for added inclusivity and enhanced cross-sectoral and multi-level communication have led to better decision making at the landscape levels. Examples with long-term data documenting trajectory of decisions include the Malinau research forest in Indonesia (Wollenberg et al., 2007), and the Sangha Tri-national landscape in West Africa (Sayer et al., 2016b). In the case of Malinau District in Indonesia, forest conservation efforts had to address a weak institutional setting and challenging politics (Wollenberg et al., 2007). Participating actors including conservation scientists and managers recognized they were part of that institutional context, not separate from it. In response, they learned through the political and institutional uncertainty to develop ways of

cooperating based on regular contact, maintaining a physical presence, staying sensitive to the needs of diverse actors, and being flexible (Armitage et al., 2012). Both cases show how long-term collaborations between different scientists and local knowledge brokers enriched the discussions amongst all stakeholders. The enhanced relationships and discussions allowed for a better understanding of, and adaptation and response to the main drivers of change in the landscapes. The use of theories of change and place, network analysis, and discourse analysis can value add in the long-term strategy for embedded science if these tools are used flexibly to optimize institutional arrangements.

Bridging Epistemological Divides

Framing and solving complex problems of forest landscapes requires drawing upon a range of disciplines and epistemologies (Wiek et al., 2011). Epistemological differences are difficult to rectify in the bureaucratic structures and incentives for career development that encourage the "fence and defense" attitude to one's research area (Haider et al., 2018). Straddling academia and practice, a growing number of sustainability science practitioners sympathize with Robert Chambers' notion of being ill-disciplined (Chambers, 2014a). The authors of the present paper are a collection of early career researchers, mid and late career researchers and applied scientists, from diverse backgrounds that have all worked to reconcile local vs. global conservation and development values in forest landscapes in the tropics. We label our approach "practical" political ecology. Practical political ecology is where resilience thinking meets political ecology, applied science and transdisciplinarity. Political ecology explicitly aims to bridge the natural and social sciences and address power and scale. Resilience thinking represents the latest in social-ecological systems concepts and frameworks (Brown, 2015). We take the practicality of understanding systems and power politics to mean engaging constructively with actors on the ground, rather than deconstructing how things are from afar.

It would be naïve to expect complete impartiality on behalf of scientists; we are humans with our own ontologies that suggest to us what deserves our attention. To help address this, complexity, systems thinking, and facilitation could become part of a standard science education. Current incentives for early career researchers favor laboratory-based meta-studies, remotely sensed problem diagnosis, and reductionist single species or single factor studies that are readily published in journals (Courchamp and Bradshaw, 2017). The messy real world of rapidly changing forest landscapes challenges science that is driven by simple hypotheses. Systems science (Sayer and Campbell, 2004) and sustainability science (Clark et al., 2011) require deep long-term engagement with diverse stakeholders by transdisciplinary teams focused on addressing the real problems of actors in the landscapes (Balvanera et al., 2017). To address these problems means being a part of networks of influence, working "with people, not on or for them" (Chambers, 2012).

This sort of science usually takes the form of interdisciplinary bodies rather than individual experts. It draws on diverse perspectives to integrate scientific knowledge and policy options

and acknowledge uncertainty. It calls for honest brokers—individuals or bodies that seek to widen the range of policy options in a way that allows decision making based on preference and values (Pielke, 2007). Honest brokers exist in contrast to issue advocates that align themselves with a particular political agenda or interest group, often cherry-picking evidence to make the case for their agenda (Huitema and Turnhout, 2009). If scientists act as "honest brokers" rather than "issue advocates," they will likely increase the impact of their findings on natural resource policy-making (Pielke, 2007; Chambers, 2014b).

Honest broker bodies can broker knowledge by forming new hubs of information to serve the needs of decentralized management (IDLO, 2016; Sayer et al., 2016a) These hubs would best serve if they included inventories of knowledge on the full range of assets within a landscape: human, social, financial, physical, and natural. Scientists could build knowledge inventories in collaboration with, and accessible to, other scientists from a range of disciplines, as well as all of the actors in the relevant landscape. More complete and transparent inventories will lead to more representative transdisciplinary problem framing (IDLO, 2016; Brondizio, 2017). Arts and De Koning (2017) have already shown that community forest management will have a greater likelihood of success if local groups are linked by a Community of Practice to diverse groups that include external forest scientists. We suggest that embedded science should drive those linkages and shift Communities of Practice toward "Communities of Commitment." These are communities of collaboration, mutual support, solidarity, and shared inspiration (Chambers, 2012). Communities of Commitment should lead to more specific understanding of problems and their potential solutions.

Trialing Embedded Science

The authors of this paper are part of a team of researchers and practitioners that try to embed science into local forest landscapes to improve decision-making for better conservation and development trajectories across the tropics. We work in "sentinel landscapes," where we apply landscape approach principles and hope to engage for the long term. Much of our work takes place in Indonesia. We present two contrasting cases where local contexts, resource constraints, and the results of taking the approaches described heretofore have led to different local landscape outcomes. Lessons learned from our previous attempts at collaborative science in Malinau (Gunarso, 2007) the Sangha Tri-national landscape (Sayer et al., 2016b), and Lombok (Riggs et al., 2018a) are informing our attempts to foster embedded science processes in Seram and Riau.

Lessons From Seram, Maluku, Indonesia

In 2017, our non-government organization, Tanah Air Beta, an association of scientists interested in applying science to achieve productive and sustainable land and seascapes, embarked upon a program to trial a landscape approach on Seram. Our objectives were to diagnose the current issues effecting landscape functionality and determine where coordination and commitment might leverage more sustainable landscape outcomes for both conservation and development. The project

is funded by a donor, the Critical Ecosystem Partnership Fund, whose mission is to secure the long-term viability of certain endemic species that have led to parts of the island being designated as key biodiversity areas (KBAs). Our approach is to work with local communities and the administration to improve long-term stewardship of natural resources and address problems that are locally diagnosed. We have been returning to Seram for extended periods since early 2017.

Our efforts to embed science started with network analysis of the actors influencing conservation and development outcomes in the region. Actor and policy network analysis helped us come to terms with the complexity of actors and their influences in the landscape. Early analysis showed that government and civil society organizations were operating in parallel silos (Liswanti, 2012). We sought to convene meetings with actors that had not been coordinating with each other, but whose mandates might benefit from better cross-sectoral information sharing and collaboration. Through this process we have begun building consensus for what we hope to be a long-term collaboration with universities, local NGOs, and government agencies identified from that process.

A case of environmental pressures stimulating needs for environmental intervention emerged on one of Seram's small surrounding islands, Boano. There, monoculture development of *Melaleuca cajuputi* and the demand for firewood to make oil from harvesting melaleuca leaves is degrading the environment and negatively affecting livelihoods. Our interdisciplinary team of students, teachers, and researchers spent valuable informal time living with the local communities, building interpersonal relationships. We collaborated with the local natural resource management (NRM) organization Lembaga Partisipasi Pembangunan Masyarakat (LPPM) and organized numerous discussions with the different community groups. To understand context in a communication style that was more inclusive we used visualization methods (Boedhihartono, 2012) to co-construct inventories of historical change data, and current and future scenarios of landscape change. These methods opened up discussions about the memories and stories that shape the local landscape identity. We developed an understanding of their environmental, social, and political pressures. We have since began working with LPPM and local leaders to co-produce a landscape development strategy. This continues, iteratively, to involve village meetings where, with our partners, both local and international NGOs, and leaders from the provincial University (Universitas Pattimura or UNPATTI), and relevant district and provincial level government authorities, we have started the messy democratic debates over the future of development in Boano.

A difficulty with this work has been addressing the slow variables of change while meeting 2 year project cycle deliverables. Though we have started co-constructing theories of change with local partners, these do not synchronize with normative project deliverables. Bureaucratically heavy "terms of reference" for our engagement require certain deliverables that do not create a space for institutional bricolage, in which bottom-up processes drive optimal institutional arrangements.

In documenting these processes, we shall strive to influence downward accountability beyond the duration of our project, ensuring future activities by the donor are less top-down driven, and more appropriate to local socio-political conditions. We prioritize processes that will lead to long-term institutional coordination, recognizing the diverse and dynamic needs of local communities. We are wary of unrealistic expectations of actions such as village agreements to guarantee conservation. Specifically, we are conscious of social wounds from past violent conflict that contributed to the degradation of resources and poor governance. While this limits our capacity to monitor progress, we accept this as a short-term trade-off and seek to develop accountability mechanisms for resource use improvements with local partners as we continue.

Our constraints led us to changing our strategy from being prominent conveners, to zooming-in and out as "peripheral agents." This strategy emerged from a collaborative theory of change process, done with local organizations identified in the network analysis. Peripheral agents implement change by brokering trust between centrally located "motivators" or influential actors (Andrews et al., 2017). Being peripheral involves being a less prominent convener or bridging organization (Kowalski and Jenkins, 2015). It involves fostering better connections with influential groups and more effectively mobilizing their engagement with one another. As we recognize our limitations in influencing the politics and market forces driving investments in Seram, we engaged at higher levels to open up information sharing networks and cultivate relationships with government authorities responsible for allocating development resources and developing spatial plans. Through this time, we have continued supporting local partners, maintaining face-time to improve our trustworthiness as "honest brokers" with local communities as opposed to taking control of the problem and solution making process. As peripheral agents, we are strategic in convening participation in ways to avoid falling into the trap of a tyranny of participation as described in the Power Relations section above. We rely on and supplement the capacity of the institutions that evolved from conflict resolution to NRM related activities—a kind of institutional bricolage.

In the process we have shed light on issues that were unseen by political leaders and decision-makers. We have reacted to local power arrangements by maintaining a position of interest in the place, rather than side with political or sectoral interests. We can safely claim success in breaking down some institutional barriers between actors in the network. Cooperating with local NRM institutions ensures that we make progress toward donor driven goals of improving resource management, while focusing our efforts on facilitating better environments for bottom-up driven development strategies. Lessons learned from a previous landscape study in Malinau, North Kalimantan, involved the prominence of strategic government involvement (Wollenberg et al., 2007). In Seram we have made sure to include different influential sectors of the government in the dialogues, problem-framing, and strategies for better adaptive and inclusive development plans.

Lessons From Riau, Indonesia

Drainage and clearance for oil palm and fiber plantations has had a major impact on the peat swamp forests of Riau Province in Indonesian Sumatra over the past three decades. Protection of remaining forests and restoration of some ecosystems on deep peat are now the object of major investments at a landscape scale. Several small-scale pulp and paper companies are involved in the initiative, which is led by the APRIL (Asia Pacific Resources International) Group. In 2013 APRIL established the Restorasi Ekosistem Riau (RER) to protect and restore 150,000 hectares of peat swamp forest on the Kampar Peninsula. Part of this process included the creation of a Stakeholder Advisory Committee (SAC) comprising of independent forestry and social experts to advise and monitor progress toward APRIL Group's sustainability goals. The Committee performs three crucial roles of embedded science; it provides a platform for scientists to engage with stakeholders, it enables system-wide learning through improved transparency and communication, and committee members act as honest brokers, using an independent verification auditor to monitor progress. In contrast with Seram, the landscape approach in Riau is driven by an industrial corporation. There are inherent power imbalances in the landscape, but independent verification creates opportunities for science to draw attention to these issues and respond to them through stakeholder negotiations and communication. APRIL funds supporting the work do not have strings attached, as in the above case. Instead, they offer a comparative advantage of long-term well-funded commitment (the ecosystem restoration concession is licensed for 60 years, with a commitment by APRIL of USD100 million for the first 10 years), with financial and reputational incentive to achieve a well-functioning landscape.

The first phase of the landscape initiative in RER included excellent scientific analysis of the spatial patterns of land use to develop ideal scenarios for biodiversity conservation in the landscape. However, initial attempts to outsource the landscape diagnosis and planning to an international conservation NGO failed to achieve impact on the ground. These ideal landscape plans had little traction with local land managers who were responding to short-term imperatives. Change in the landscape results from multiple decisions of numerous local landholders and officials. Improving the performance of the landscape in delivering societal benefits requires that science should influence all of these multiple decisions. The dispatch of an ideal map of the landscape—"To Whom It May Concern"—did not achieve the desired outcome.

To improve collaboration with local landholders, the RER management team conducted a second phase of the landscape analysis. Managers of the landscape, the people taking daily decisions on plantation establishment and silviculture, were in daily contact with other landscape stakeholders. They recognized that landscape stakeholders controlled the resources necessary to change the landscape. The managers from the companies and scientists had seats at the decision-making table and were able to negotiate with the full range of operators intervening in the landscape. This did not lead immediately to an ideal landscape outcome but it did enable sharing of knowledge and concerns. Committee members were able to advise on appropriate action and strategic direction, while ensuring the negotiation process remained in the hands of the stakeholders themselves. In close proximity to companies and policy makers, scientists brokered knowledge between the multiple levels of decision makers, maintaining cohesion between local landscape needs and broader sustainability principles.

In 2017, we brought together landscape practitioners from both landscapes, among other Indonesian landscapes facing sustainability issues together to learn about the challenges and opportunities for improved landscape sustainability. We performed a discourse analysis using Q-methodology to make the values and perspectives that people hold from both places more transparent (Langston et al., 2019). The results of which show how poor governance is the main motivating factor for pursuing landscape approaches that involve further embedding science to influence the narratives that drive political decision making in both places. One clear message is that embedding science means accounting for and addressing diverse political vantage points. Since then we have been forming a community of practice of scientists partnering with private sector, political departments, and civil society organizations. This ongoing venture is funded by the Tanoto foundation, a foundation set-up by the umbrella company of APRIL, Royal Golden Eagle.

Still in its early stages, the landscape initiative in Riau continues to foster negotiations between needs of local stakeholders, government requirements and business sustainability. A radical transformation to an ideal landscape based on external science proved impossible. Deep engagement of company scientists with local land managers did enable incremental improvements in landscape performance. The lesson is that ideal science-based plans may be less influential than embedded scientists with "skin in the game" and a seat at the negotiating table.

CONCLUSION

Local management has the attention of governments and scientists. In the context of this relatively recent attention and the related decolonization of management systems, there is a window of opportunity for scientists to become more integrated into local management processes as honest brokers, reflexive in their role and position in society. Scientists interested in influencing how society-nature relations can be improved should endeavor to collaboratively problem frame and co-generate knowledge that steers local activities toward policy and management decisions based on that knowledge. Local forest management initiatives that do not harmonize with local governance arrangements, capabilities, and learning mechanisms, risk losing any socio-economic or ecological gains that might have been achieved through local management. If scientists are to influence local forest landscape development trajectories, they must become part of the networks of influence. This will require diagnosing institutional arrangements, being inclusive of the perspectives and knowledge types of actors influencing local forest landscapes and partnering with local knowledge institutions and processes

for continual learning. There are emerging approaches to help diagnose and nudge narratives toward better science-policy-management regimes. We have adopted a series of sentinel landscapes where we work with local partners to co-generate knowledge to learn from and influence the behavior of resource dependent people. Two of these are summarized above. We seek to join the other agents of change in these landscapes (Sayer et al., 2016a). Academic scholarship should allow for embedded landscape science that can drive a process of negotiation, consensus building, and behavioral change (Pressey et al., 2017).

AUTHOR CONTRIBUTIONS

JL wrote the manuscript and conceived of the paper. All other authors contributed to the conceptual framing and provided examples from their personal experience.

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Conclusions and future research

Conclusion

I began my research as part of a transdisciplinary team undertaking place-based sustainable development research. I asked (1) What are leverage points in landscapes for interventions that lead to long-term sustainable development outcomes? (2) What are the impacts of Spatial Development Initiatives on livelihoods and the environment within a landscape? (3) How might research better support co-learning to improve processes and outcomes of landscape change. In the preceding chapters I have presented cases where we trialed various transdisciplinary and sustainability science methods to answer those questions. Our experiences inform what we call embedded science. Embedded science describes both our approach, and an overarching lesson-learned from our research, but it is not a 'framework'. Embedded science can be considered an ethos which grew out of the lessons learned of trying to take science from a supply-side, exclusive knowledge production activity, to a demand-driven, inclusive approach in the field.

My overarching discovery is the importance of closing vertical and horizontal gaps between sectors and scales. Such gaps exist between science and practice, the global and local, between disciplines, and between government departments. Bridging these gaps should be a high priority if we are to address the major threats facing contemporary society. These threats, identified at the beginning of this research, include threats to nature, rising socio-political inequality, and lingering poverty. Calls for system integration are not new (Liu et al., 2015). But my findings relate to how this integration might be influenced by collaboratively diagnosing and collaboratively constructing the narratives that shape and influence place. Indonesian's colorfully describe horizontal gaps to be a symptom of 'ego-sektoral' behavior among government, non-government, and private sector agencies. I explored methods to strategically locate knowledge brokers and knowledge co-generators with the aim of closing those gaps.

The deep leverage points for improving landscape sustainability lie in the narratives that determine decision-making behaviors of all the actors affecting place (Abson et al., 2017, Meadows, 1999). I identified narratives that inspire conservation and development practitioners to take a 'landscape approach' to improving sustainability in Indonesia (Langston et al., 2019).

Our case studies support the conclusions from the discourse analysis, that governance constraints are the major obstacle to achieving sustainability in Indonesia, and that governance perspectives are inherently political. Spatial development initiatives are likely to drive up inequality in places where governance arrangements do not serve local interests or are not matched to a principle of subsidiarity. I observed in communities in North Sulawesi (Langston et al., 2015), that shocks to a system, in that case conflict against outsiders over access and use-rights to high-value natural resources, led to the bottom-up construction of strong institutions that managed assets more inclusively and sustainably. I observed in communities in West Kalimantan (Langston et al., 2017), that local governance arrangements evolve to make decisions that serve community interests, decisions that outsiders might think are counter-intuitive but in fact are based on a hind-sight biased understanding of what constitutes 'good development'. In the case of both studies, I learned that local communities engage with large-scale industries out of a desire to reap greater economic rewards from the resources available to them. This can lead to decisions over land-use that result in landscapes that appear different to the idealized 'multi-functional' or 'working' landscapes imagined by environmental scientists– but are nonetheless providing a broad range of benefits to those landscape equity holders that have the most to lose (Kremen and Merenlender, 2018, Fischer et al., 2017).

In East Lombok I discovered how institutions affecting landscape development outcomes could be better coordinated so that local governance arrangements harmonize with goals of provincial authorities and other external actors to achieve improved sustainability (Riggs et al., 2018). The final case study presented in this thesis, Seram, is a place where I observed that existing institutions are comparatively less prepared to manage environmental and social threats of incoming large investments, mainly due to costly conflict and gaps in the exchange between political economies and western Indonesia (Langston et al., Submitted). In both places, I learned how boundary organizations need to be flexible and to adjust their positions in the actor-networks affecting decision-making to nurture enhanced local governance arrangements.

When local people are faced with large-scale development opportunities, threats to environment and livelihoods exist. But these do not necessarily lead to long-term losses, or 'dysfunctional' landscapes. Local evolution of institutional arrangements responds to exposure to different types

of knowledge and shocks to the system. The evolution of these governance arrangements to address threats are what determine the inclusivity and sustainability of landscape development trajectories. It has been asserted that "development is not a panacea for the environment" (Cumming and von Cramon-Taubadel, 2018), but according to our observations, it is our best, if not only, viable option, and it hinges on governance.

Indonesia's governance systems face the same adaptation challenges faced around the world, where technological advancement outpaces social adaption rates (Friedman, 2017, Boedhihartono, 2017). In eastern Indonesia, decentralized management paired with disconnectedness has led to infrequent exchange, slowing the adoption of new knowledge and technology (Margules et al., 2015). As changes occur more rapidly, and on a larger scale, governance arrangements will evolve. Organizations that wish to improve decision-making processes toward enhanced sustainability and inclusivity should seek opportunities to more strategically leverage change. This requires diagnosing the entire social-political-economic-ecological system. Efforts should be made to bridge gaps between traditional and State management systems. If civil society engages in the institutional bricolage – the emergence of new institutions from system disruption (Cleaver, 2017), this could result in adaptive handling of the incoming investments in ways that benefit local people and help ensure long-term, wise stewardship of natural resources.

There remain obstacles to embedding science to improve decision-making processes in landscapes. The tasks trialed and set forth in the prior chapters are logistically complicated and physically demanding. But there are enormous opportunities for research to influence the root causes of the divergences that embedded science tries to rectify. Future research might interrogate how to begin influencing donor priorities. What approaches can help achieve downward accountability from donors so that they respond to the demand-side issues faced by the organizations they fund? Operational strategies of donor groups should be influenced to build in robust transdisciplinary place-based diagnostics, and to accommodate bottom up agenda setting to their mandates, because addressing local contexts is vital to achieving long-term sustainability. Our research team will continue trialing ways to better embed science in inclusive and just ways to improve sustainable development trajectories. This will involve searching for

new avenues that lead to more demand driven research. Our research will investigate how to alleviate the costly constraints of place-based transdisciplinary science and how to change academia's incentives and approaches to research in ways that enhance governance systems *in situ.* Indonesia's development progress as measured in norms set forth in the Sustainable Development Goals set in Agenda 2030, are encouraging. In Indonesia and beyond there is much rhetoric about bottom up and demand driven development interventions. The reality is that there is a powerful undercurrent of centralization of control (Bull et al., 2018, Boedhihartono et al., 2018). Achieving equitable and sustainable local development requires reversing this trend. The incentive systems for scientists and the culture of conservation and development organizations need to shift. The local people who are supposed to be the ultimate beneficiaries of interventions must have far greater involvement in setting and assessing priorities. Feedback loops need to be shortened to foster a continuing process of learning and adaptation to truly empower local actors.

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